Tech-Enabled Dairy Farming: Empowering Small-Holders for Profitable Growth

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Abstract—India has achieved the status of being the largest producer of milk for more than three decades now but has been unable to become a net surplus country. As a result, India is still a non-player in the international milk market. There is only one way of looking at the status. The growth rate in milk production over this long period of over 30 years has been unable to outgrow the growth in domestic demand. This means that the existing incentive for enhancing growth in milk production is by way of increase in the price of milk, cow dung and urine at the farm gate and the salvage value of the animal are insufficient vis-a-vis rising cost of inputs. And the industry players of all hues and colors with complete protection from external competition vide appropriate policy have become self-conceited. At the numero uno position, this is simply unacceptable; for the lives of millions of farmers across the country are dependent on it for income and nutrition! Dairy contributed 5.3% of agricultural GDP[1], with milk as the leading agricultural produce! The growth rate in milk production is said to have been 5.6% in 2020, down from 6.5% in 2019. In 2020, the milk production is said to have touched 198.4 million metric tonne[1]. Importantly, smallholding dairy farmers contribute more than 90% of the milk produced in India. Dairy animal rearing, a sub-sector of Indian agriculture, is supplementary and symbiotic to agriculture. It adds substantial and a regular income to more than 75 million households in India, directly. Of the several constraints that a smallholding dairy farmer faces, the first and most important one, one that has not been addressed to date, is the lack of credible and timely information on key technical and financial parameters about their own individual animal with the relevant point of reference for comparison. The two when put together automatically establish a self-learning feed-back loop. Interestingly it is also one that is easily surmountable with the information and communication technology available today in terms of hardware and software.

This conceptual research paper focuses on unraveling this blind spot at the individual animal level such that the smallholding dairy farmers are able to enhance their profitability through a process of self-learning. This is attempted by converting cross-sectional data of daily milk production into a longitudinal data i.e. lactation graph and peer pressure. This is to enable the farmer to reduce

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the risks involved and cost of production and marketing, on her/his own manner and will. The resultant incremental profit is expected to encourage them to produce more milk from their existing animals. A move from sub-optimal to optimal position, in a way. This is expected to be achieved using simple visual tools vide application on one's smartphone, with the data updated, verified with Participatory Guarantee System (PGS) and be available 24x7 free of cost to each farmer at an individual animal level, as private information along with the mean, median, mode, standard deviation, maximum, minimum of a predefined cohort of animals, as public information.

I. INTRODUCTION

Dairy industry is expected to grow by 9-11 percent in 2021-22 and domestic milk production is estimated to increase by 5-6 percent during the financial year 2021-22. Uttar Pradesh with 30.4 million metric tonnes (MMT) (16.3%), Rajasthan with 23.7 MMT (12.6%) and Madhya Pradesh with 15.9 MMT (8.5%) are the top three milk producing states in our country. Dairying in India is an occupation of small farmers. Over 60 percent of 11 million farmer members spread over a lakh village milk cooperatives all over the country are small, marginal and landless producers [4]. Small dairy households are face numerous challenges such as unremunerative price for milk, compulsory credit sale of milk, shortage of quality feed and fodder, low genetic potential of dairy animals resulting in low productivity levels, non-availability of institutional finance, poor animal health-care facilities, near absence of extension services, and rural infrastructure. [5]. In addition to these, the major challenge has been the non-availability of authentic and timely information on key technical and financial parameters in an easily understandable form to guide the farmers in making necessary decisions to enhance milk productivity.

Information Technology could play a crucial role in dissemination of information in real time. Tools like AI, Data Analytics, Blockchain, IoT can easily be used for collecting and analyzing large volumes of data. Data about the health of cows could be collected, for example, by motion sensors worn by the cows and sensors attached to milking robots. [6] Nowadays Farm Management Information Systems (FMISs) are capable of processing detailed sensor data and providing extensive decision-support functionalities. [7]. Machine Learning (ML) is a subset of AI (Artificial Intelligence) and uses complex algorithms to solve challenging problems that are difficult to solve with traditional approaches [8]. However, for smallholding dairy farmers these technologies are high cost and difficult to understand and use. There are several software / applications for Dairy Farmers from the Government and private agencies. Majority of these are for large dairy farms. The requirement of simple application which can be easily understood and used by the smallholding dairy farmer having just 1 or 2 animals, seems to be simply absent since it may be difficult to encash it and monitor its usage.

II. AIMS OF THE RESEARCH

The research paper highlights the importance and necessity of

1. Providing a simple mobile application to individual dairy farmers, wherein they can record daily milk production of their animal on their own volition, totally free of cost but with full and total control over the individual animal-wise information as a private good.

2. Providing the small dairy farmer with reference points on various technical and financial parameters to initiate a self-learning feedback system, on a day-to-day and dynamic basis, as a public good, again free of cost.

3. Enthusing the small dairy farmer to enhance profitability of their business of milk production and sale by reducing the risk and cost and cash out-flow as well as improving efficiency, simultaneously.

III. LITERATURE REVIEW

Dairy farming has always been an area of attraction due its contribution towards the health and wealth of the nation. Dairy farming in general and smallholding dairy farming in specific has undergone several changes with many done on the basis of organized research in these areas. [4] The study attempts to analyze the nature and extent of the contribution of dairying to income, employment and food security of rural farming households. [11] The study indicates that given the frail backdrop of dairy farming in India, continuing dairy activity in the near future will differ based on the farming system and market opportunities.[12] Lalgoulen Khongsai in the research study found that there is ample room for promotion, production, and distribution of liquid milk and its products, which policymakers and dairy industry can use it in their favor. [13] The study suggests that support (in the form of subsidy) should be provided to small scale dairy farmers for accessing land and provender and awareness about the importance and scope of small scale dairy farming as a stable career opportunity should be spread among the young generation. [14] The article brings to notice the insurgence of large multinational firms which are competing to reduce the price of milk sold in cities, thus squeezing margins for dairy farmers. [15] J. Banda and others conclude that Smallholder dairy farming is not only a source of household income, but also a major contributing factor to household resilience, food, and

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nutrition security. [16] Ganesh. B. Kumar in the book Sustainable Livelihoods an Adaptation to Climate Change (SLACC) provides details of Nutrition and Health Management specifically relating to smallholding dairy farmers with respect to enhancing income. [17] The authors of this research conclude peri-urban dairy systems in India are important but also varying between different cities, with only one city, Bengaluru, having a well-developed cooperative system, and the northeastern poorer region being more dependent on traders. [18] The study found that the emerging opportunities were not strong enough to retain the youth and increasing demand for dairy products pushing the "traditional crop-dairy integrated mode of dairying" to "moderate intensive farming" with replacement of milch animal stock, feed resources, mechanization and with minimal dependence of animal power traction. . [19] This paper examines adoption rates and adopter characteristics for dairy technologies, and concludes that except grazing, technologies were generally complementary. [20] The study results show that other than higher capital costs, the use of AMS (automatic milking system) rather than a CMS (conventional milking system) did not affect farm efficiency and that the learning costs to use an AMS were not present as measured by any decrease in technical efficiency. [21] The main finding of this study is that FMISs (farm management information systems) support farm management effectively, which translates into lower costs, increased product quality, improved animal welfare, and an overall increase in safety. [22] The authors of this study show the need to generate differentiated public policies for each cluster, aimed at strengthening the aspects that have allowed them to survive and guaranteeing a market for their production, before promoting the use of technologies. [23] According to the authors, improved access to symmetric information and use of specialized bespoke extension approaches for livestock farmers should be encouraged to adequately translate awareness of technologies to utilization and adoption capabilities of small farm dairy cattle holders and indeed livestock farmers. [24] The study suggests that due to perceived ease of use and perceived usefulness positively influence the intention to use such apps and ultimately the actual usage behavior, developers and providers should highlight the benefits of using herd management smartphone apps and also keep the interface of the apps as simple as possible. [25] The study concludes that researchers and extension experts need to be familiarized with the use of mobiles to disseminate information and improve productivity in the dairy sector. [26]According to the research study actual utilization of mobile based ITC tools by dairy farmers is poor in terms of its use for the purpose of dairy related activities. There is a need to popularize the use of mobile based ICT tools and impart competence and skills in its use among the dairy farmers.

IV. METHODOLOGY

The conceptual research takes into consideration the current scenario of small holding dairy farmers and proposes to provide them comparative details of the milk produced by their own animal along with a standard value. The details given in graphical format through a user-friendly mobile application. This will help the farmer take necessary encouraging actions pro-actively to reduce cost and enhance quality and profitability. The enhanced profitability is expected to motivate the farmer to increase the milk production from his animals
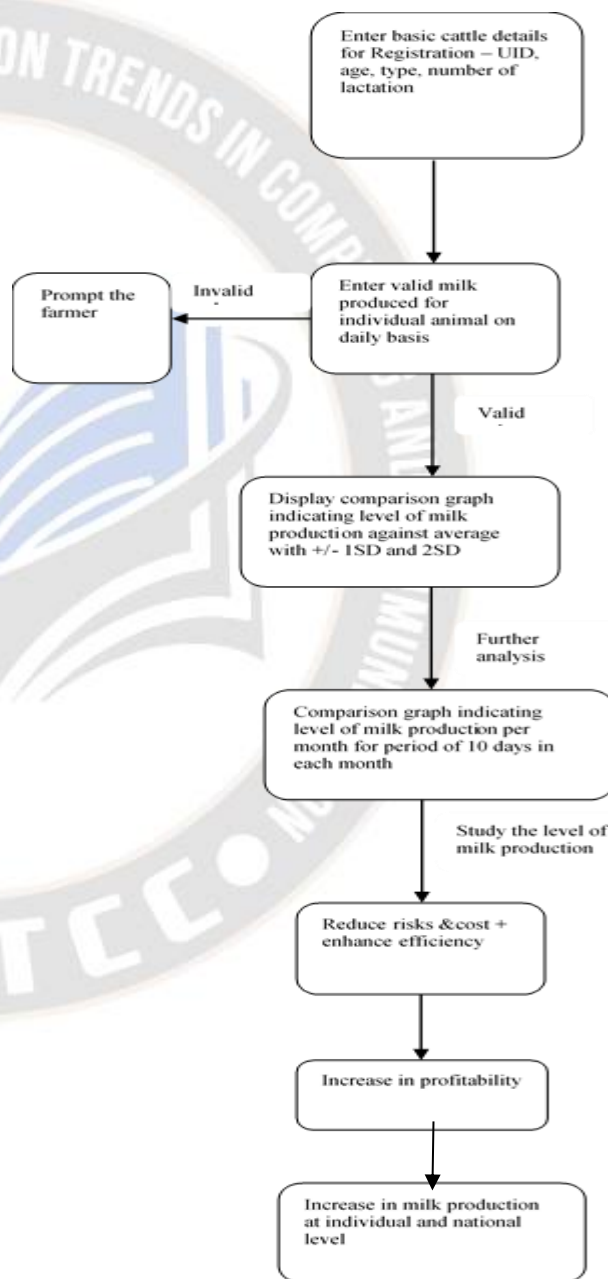

Fig 1: Flowchart to represent the working of mobile application

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V. DISCUSSION

Leveraging IT to provide the dairy farmers with essential information required for enhancing profitability and hence production is one of the solutions to further help boost dairy farming in India. The current IT solutions available are for use by large dairy farms or organizations that have a group of small holding dairy farmers under their fold. Software applications specifically for small holding dairy farmers are simply not available in the Indian market.

1. Stellapps is one of the prominent players providing technology for every process in the dairy farming management and is relevant for huge dairy farms who can afford to buy and use the technology.

2. PashuPoshan, a free IT solution provided by the Government of India, focuses on the nutrition and quantity and type of feed to be given to the dairy cattle.

3. e-Gopala is also a free mobile application by the Government of India is a platform for selling products online.

4. MoooFarm, mobile application provides connect to qualified Veterinary through audio and video calls, allows record of income and expenses through eDairy Passbook, records health and breeding dates and provides information through MoooSaba a community for dairy farmers. The IT application is more to reach out to various service providers.

5. Inhof – Dairy Analytics Platform is also providing technology for medium and large size dairy farmers.

6. Dvara Surabhi Index, mobile application helps to identify health index of cattle using specific cattle image supported with cattle specific details provided by the dairy farmer.

Thus, there is a need for a simple IT application to monitor the daily milk produce for individual animals for a small holding farmer. Accordingly, it is proposed to design a mobile application which will be designed specifically for small holding dairy farmers. The application will have the following features:

a. Available in local language
b. Free
c. Application code to be open source

The application will work in the following manner:

1. **Registration**:

The Registration will take place at 2 levels.
i. Registration of farmer
ii. Registration of individual animal
Every animal has to be registered individually by providing details like - UID, Name, Age, Breed, and lactation number.

2. **Recording milk production,** lactation number wise
The Farmer will make a daily entry of the milk produced by an individual animal. Before making the daily entry the farmer is required to select the lactation number. The data available is lactation number wise as well as the life-time milk production across all lactations.

3. **Comparative Reference Graph:**

Based on the values submitted on a daily basis lactation curve can be drawn on daily basis or 10-day basis or 30-day basis as desired and displayed in the mobile App interface indicating the actual performance of the animal as against a standard lactation graph with +/-1 standard deviation, for a specific lactation number, breed etc.

The application will also provide a comparative graph against the record of previous lactations, incase such data is previously entered in the application for the same animal.

Outcome:

The mobile application is supposed to provide comparative graphs for the farmer as a ready reckoner to compare the milk produced and develop a strategy to enhance the quantity and quality of milk produced by the animal.

Comparison will also be provided across lactation numbers. This will help the farmer draw helpful conclusions about the animal on a long-term basis and make / take suitable decisions.

Use of milk production data

The data collected through the mobile app is used to display the milk yield in a longitudinal form vide a graph for the dairy farmer. This use of this information can be further extended to provide the following financial products:

i. Cattle insurance against mortality and morbidity: Based on the output drawn from credible data, the animal can easily be monitored resulting in animal or farmer-wise insurance products with a lower premium since there is little or no information asymmetry for each animal between the farmer and the insurance company.

ii. Short and Long-term Credit for animals: The graphical information can also be used by the formal financial institutions like banks to provide tailor-made short and long-term credit that too on a dynamic basis to the farmer based on the milk production data of the animals.

iii. Credibility of data: The data collected through the application can be verified and acknowledged by a PGS (Producer Guarantee System). Five-star rating for truthfulness of data is given by default. However, the rating will get reduced through a penalty system for individuals and the collective for anything which reduces the validity of the data entered. And this can be used by the financial institutions to provide their services, appropriately.

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Mobile Application: The proposed mobile application is for smallholding farmers to provide information in graphical format with reference to a standard or threshold. The information should be used by the farmer to take actions to enhance profitability and increase quality and quality and market value of the milk produced. The real time graphical information should enthuse the farmer to plan for enhanced milk production.

The proposed mobile application will be developed using following software's

1. Android Studio
2. MySQL Server (can change as per server hosting)

For Web based dashboard

1. Visual Studio 2019

For API hosting we need CPANEL / FTP access to web hosting providers.

VI. CONCLUSION

Inspite of India being the largest producer of milk in the World for the past 30+ years, it is still not net-surplus. Hence, it is not a even a player in the international milk trade! Not a very happy story to be writing home for the next 30 years! Small holding farmers are the major contributors to milk production in India. Hence, the key to higher growth in milk production lies with them and them only. And that can be achieved by enthusing them with higher profit and peer pressure arising from a dynamic self-assessment process in an easy manner to lower risk, cost and cash-outflow and increasing efficiency simultaneously, leading to higher profitability. Solutions to this is already available in the Information and Communication Technology space and are probably already being used elsewhere. Once adopted, India can then be able to move into the next rightful position of net surplus in milk as a country and will become a player in international trade for milk. As a result, India will have made the first step towards continuing to be a self-sufficient country for milk.

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