

Transforming Livelihoods: Ensuring Equity and Sustainability Through ICT

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ABSTRACT

Enhancing livelihoods of rural poor is crucial for poverty reduction. Livelihood perspectives started influencing development thinking in the last couple of decades and were considered to provide a holistic understanding of poverty. Sustainable livelihoods concept is built on the notion of capability, equity and sustainability where all of them are considered both ends as well as means. Globally and in the Indian context a number of programmes are getting implemented to enhance the livelihoods of rural poor. Information and communication technologies (ICTs) started playing a pivotal role in implementation of these livelihood programmes. This paper looks at the case of implementation of ICT in a dairy intervention, under Indira Kranthi Patham (IKP), a livelihood enhancement programme. The programme is implemented by Society for Elimination of Rural Poverty (SERP), Government of Telengana. The introduction of digital technologies like Smart Data Processor Milk Collection Unit (SDP-MCU) and Smart Automatic Milk Collection Unit (SAMCU) helped in building trust among dairy farmers and maintaining transparency in the dairy intervention. This also helped in ensuring equity and sustainable livelihoods where rural women from low income households were the primary members in the intervention. Technology coupled with strong community based organizations like Village Milk Producers Organization (VMPO), Mandal Mahila Samakhya (MMS) and ZilaSamakhya (ZS) led to sustainability of the intervention.

Keywords: Sustainable livelihoods, dairy intervention, digital technology, empowerment, equity, sustainability

1. INTRODUCTION

A major challenge that continues to confront the world is extreme and excessive poverty. Poverty remains prevalent in rural areas. Globally and in the Indian context, various efforts like community development, small farm-growth and integrated rural development had been taken to address poverty. Among the different approaches to address these challenges, sustainable livelihood approaches (SLA) were considered to provide a holistic understanding to the multidimensional aspect of poverty and hence address poverty better. Securing sustainable livelihoods by people is crucial in addressing poverty. Apart from capability the concept built on the notion of equity and sustainability, where it is envisaged that everybody should have adequate and decent

livelihoods and that the livelihood opportunities of the future generation should also be taken care of.

Ever since the inception of the five year plans, in the year 1951, one of the primary objectives of planned development had been alleviation of rural poverty. Some of the major livelihood enhancement programmes that were being implemented to address poverty had been Community Development(CD), Integrated Rural Development Programme (IRDP) and Swarnajayanti Gram SwarojgarYojana (SGSY).SGSY has now been revamped into National Rural Livelihood Mission (NRLM), the present flagship programme on enhancing livelihoods of rural poor. Sustainable livelihoods thinking started influencing many livelihood enhancement

programmes, even though the shift to the approach has been mixed.

The role of information and communication technologies (ICTs) in enhancing the livelihoods of people, especially in rural areas is also gaining momentum [for example Adewumi and Okunade, 2017; Agha, Ghanghas and Chahal, 2018; El Bilali and Allahyari, 2018; Yekinni et al., 2019]. Use of ICT has not only helped in improving the livelihoods but also contributed towards empowerment of people and sustainability of the interventions. A number of ICT interventions are getting implemented in the developing countries context. However, a systemic study of these interventions and the incorporation of the lessons learnt need more attention.

IKP Indira Kranthi Patham (IKP), one of the major livelihood programmes in India, is implemented by Society for Elimination of Rural Poverty (SERP), of Government of Telengana. Among the various initiatives under IKP, dairy development focused on enhancing the livelihoods, especially that of women in rural Telengana. The various interventions under the dairy development included supply of inputs, technical support and marketing of milk. Smart Data Processor Milk Collection Unit (SDP-MCU) and Smart Automatic Milk Collection Unit (SAMCU) were introduced to build transparency and trust among the milk producers on milk procurement and payment. This paper looks at the model of information and communication technology intervention in the livelihood programme and how ICT helped in strengthening capability and ensuring equity and sustainability.

2. ICT AND SUSTAINABLE RURAL LIVELIHOODS: A REVIEW

There is a growing body of knowledge on the role of ICT in enhancing the livelihoods of people. Existing studies have looked at use of ICT in micro enterprise development, agriculture and allied sectors like dairy farming, fishery and poultry to improve livelihoods and eventually reducing poverty [for example Adewumi and Okunade, 2017; Duncombe, 2006; Lokeswari, 2016; Makau et al., 2018; Makoza and Chigona, 2012; Syiem and Raj, 2015]. ICT has been playing a significant role in the extension delivery mechanism in livelihood interventions carried out by government and other development organizations. This has helped in improving rural livelihoods because of access to timely information and services [Adewumi and Okunade, 2017; McNamara, 2008]. It has also been seen that ICT had

led to an increase in productivity, socio-economic development and standard of living in developing countries [Sennuga, Conway, and Sennuga, 2020; Shirima and Sanga, 2017]. Digital technology has helped in spiraling social capital and efficiency [Shaibu, Hudu, and Israel, 2018]. Studies have shown that information and communication technologies can improve marginalized people's prospects by improving their access to markets [Adewumi and Okunade, 2017; Cecchini, 2003]. Another significant contribution of ICT in livelihoods has been empowering rural community by way of improved access to information, services and technology [Anadozie et al., 2019; Lokeswari, 2016].

Studies have also focused on access to ICT and the factors facilitating adaptation of technology across various segments of the community. Modern Information and Communication Technologies (ICTs) has provided new ways for farmers to share information and knowledge. However, due to existing disparities in access to ICTs, many groups in low-income countries, especially women, are often excluded from using the digital technology [Parmar et al., 2018; Wamala, 2012]. Empirical research suggests that women in both rich and poor countries have less access to and use of ICT than men [Razavi and Turquet, 2016]. Fear of embracing modern technology due to lack of awareness, high equipment costs, technology limitations and language barriers are the most prominent obstacles that discourages rural farmers from using ICT. Studies also highlight that the younger generation is interested and is able to adapt modern technologies, while farmers over 45 still prefer the old method [Subashini, Pavithra, and Fernando, 2017]. Literacy, earnings and farmer's social standing are significant socio demographic factors influencing the adoption of ICT-based information systems [Ali, 2012; Mutui et al., 2019; Shaibu, Hudu, and Israel, 2018].

Even though ICTs have the potential to make a difference and to speed up information access for some farmers, issues in sustainability has been raised in many studies. Majority of ICT projects have been treated as pilots demanding more focus on institutionalizing ICT (Kisan, Wadkar, and Singh, 2013). Implementation of sustainable ICT intervention also requires collaboration with community [Chib and Zhao, 2009; Ssozi-Mugarura, Blake and Rivett, 2015]. The findings of cross-country studies in China and India show that the use of ICTs to promote rural development is dependent on institutional support, as determined by government administrations, project managers and technology agencies perceived interests, as well as

the importance to rural people and their leadership [Chib and Zhao, 2009]. A major suggestion from existing research has been that through extensive networking and partnerships with various institutes, non-governmental organisations, and the private sector, ICT technologies will aid in the strengthening of farming communities [Singh, Ahlawat, and Sanwal, 2017]. There will be more chances of poverty eradication if ICT designs are changed to meet poor community realities [Heeks, 2014, Nanda & Samanta, 2018].

The review of literature highlights the issues of equity and sustainability in terms of adaptation of ICT. This paper focuses on how proper design and institutional mechanism have addressed the issues of equity and sustainability in ICT interventions in rural areas thereby ensuring sustainable livelihoods.

3. RESEARCH METHODOLOGY

The study adopted a qualitative interpretive research methodology to understand how ICT initiatives had been implemented in the dairy intervention to improve the livelihoods of low income women in rural Telengana under IKP programme. The programme was launched on pilot basis in two mandals in two different agro-climatic regions of the state. One mandal from Mahabubnagar district representing dry region and another mandal from Nizamabad district representing irrigated region. Both these mandals were selected for the study. Ten village milk procurement centres from each mandal were selected for the study. Five village milk procurement centres were selected having more number of dairy farmers and the remaining five village milk procurement centres were having comparatively less number of dairy farmers. A total of 20 milk procurement centres were selected for the study.

Focus Group Discussions (FDGs) were conducted with women dairy farmers. Three FGDs were conducted in each milk procurement centres. Further one FDG were conducted in each mandal with the members of Mandal Mahila Samakhya(MMS)ii. It provided the opportunity for a group of women dairy farmers to share their experiences, benefits they received and impact of the programme. Semi-structured interviews were also conducted with key members of Mandal Mahila Samakhya (MMS) at the block level and Zila Samakhya (ZS)iii at the district level to understand the governance issues, business model and the economic viability of community based organizations. Semi- structured interview were also conducted with 5 key officials of Andhra

Pradesh Dairy Development Cooperative Federation (APDDCF) iv to understand the benefits, business model and sustainability of this partnership arrangement.

4. CONCEPTUALIZING SUSTAINABLE LIVELIHOODS

Sustainable Livelihoods Approach (SLA) gained popularity in the last couple of decades and was considered to provide a holistic understanding of poverty [Farrington et al., 1999], which in turn would be helpful in better designing of programmes on livelihoods. People-centred, responsive and participatory, multi-level partnerships, sustainable and dynamic are some of the core principles central to the approach. The approach was highly influenced by Robert Chambers's work on poverty, Amartya Sen's work on capabilities and Brundtland Commission's report on sustainable development. Jeremy Swift's work on livelihoods strategy also influenced livelihoods thinking. Robert Chambers and Gordon Conway, in the early nineties, came out with the influential article on sustainable livelihoods. According to them, a livelihoods comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living: a livelihood is sustainable which can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels and in the short and long term. [Chambers and Conway, 1992, p. 7]

5. THE LIVELIHOOD ENHANCEMENT PROGRAMME

Indira Kranthi Patham (IKP) is a World Bank financed livelihood enhancement programme implemented by Government of Telengana in India. This programme is being implemented by an autonomous society named Society for Elimination of Rural Poverty (SERP). The programme envisages that every poor family in the state of Telengana comes out of poverty, is stabilized against shocks that threaten their advancement, improves its livelihoods options and enjoys a decent quality of life. SERP's poverty reduction strategy is built upon three-pillar model of institution building, capacity building and economic development/ livelihood opportunities. As a part of institution building, SERP has built a huge network of community based organizations like Self Help Groups (SHG), Village Organizations (VOs)v, Mandal Mahila Samakhya(MMS) at the block level

and ZilaSamakhyा (ZS) at the district level. As a part of capacity building, SERP has created a vast pool of resource persons and grass root women leaders to support the aforesaid institutions.

5.1Dairying as a Livelihood Intervention

As a part of IKP programme, SERP initiated dairy intervention to improve the livelihoods of about 3 million rural poor, who were engaged in dairy activity, with appropriate institutional structure, business model and technology. The intervention focused on forward linkage (marketing of milk) for the dairy farmers and provides financial services to establish backward linkage (inputs like cattle feed, veterinary health services and fodder).

SERP partnered with Andhra Pradesh Dairy Development Cooperative Federation (APDDCF) to establish forward linkage. Despite owning huge milk handling infrastructure and milk marketing network, APDDCF was however, facing a number of challenges. These include low participation of milk producers in milk cooperative movement, low volume of milk procurement, low capacity utilization of milk cooling and milk processing infrastructure, inability to pay better price, quality inputs and technical services to the farmers. Analysis of APDDCF highlighted that the low volume of milk procurement is due to the trust deficit coupled with the following factors.

- Milk collection by Producers Association with no ownership of the existing milk procurement centres by the community
- Milk Collection through commission agent appointed by APDDCF, where commission agent was perceived by community as middle man
- No regular testing of Milk on fat percentage. On occasions when the testing was done, it

was through manual methods and not in the presence of the producer

- No individual pass book was maintained to record the daily milk supply by the members
- No transparency in quality testing and payment system for the milk supplied by the farmers
- Same price was offered irrespective of quality
- When the pooled milk from several villages were transported to the bulk milk cooling unit, transporters used to adulterate the same with water, thereby quality of pooled sample of milk was undermined and farmers were penalized

Under the SERP and APDDCF partnership arrangement, APDDCF handed over the existing and defunct milk producers association (milk procurement centres), mostly run by men, to Village Organizations (VO) run by rural women members. VO shall perform the role of Village Milk Producers Organization (VMPO). It will own and operate milk procurement centre, supply cattle feed and fodder seeds to milk producers on credit basis. Similarly, Bulk Milk Cooling Units (BMCU)^{vi} of APDDCF located at cluster level covering 20-25 villages was handed over to Mandal Mahila Samakhyा (MMS). The entire operation of milk procurement at the village level, transporting the milk from the village to the central village for cooling the milk at the BMCU shall be undertaken by the MMS. APDDCF shall buy the chilled milk on ex-BMCU basis on pre-determined price which will be negotiated by Zila Samakhyा (ZS). At the district level, ZS also provides community based livestock insurance services and undertakes bulk purchase and supply of fodder seed and cattle feed to MMS.

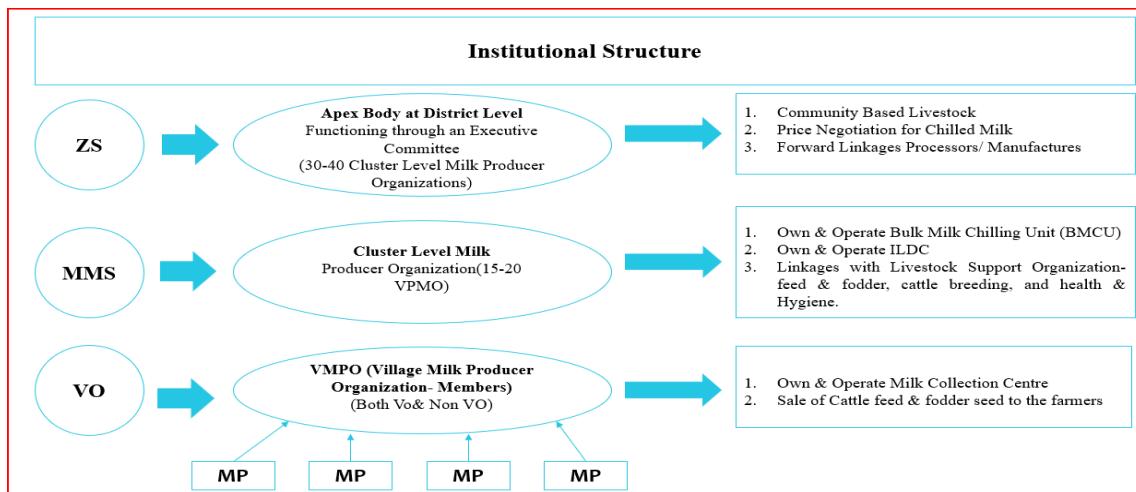


Figure 1 Institutional Arrangement in the Diary Intervention

It was also decided that the entire backward linkage operation (supply of inputs and technical services) will be carried out by MMS. The MMS shall improve the existing milk collection center or set up new procurement centre by mobilizing women milk producers and adopting transparent procurement and payment technology systems in both Milk Procurement Centre level as well as BMCU level. It will also put in place its own method of bookkeeping, management information system along with financial and administrative procedures at the Milk Procurement Centres and BMCUs. A tripartite five-year agreement among MMS, ZS and APDDCF on operation and management of bulk milk cooling unit of APDDCF was executed.

The programme governance structure consist of dairy functional committee of 5 women milk producers at VO level, Management committee at MMS level consisting of one dairy functional committee member of each VO affiliated to MMS. Similarly, the executive committee at ZS level consists of one management committee member of each MMS, representative from APDDCF and one representative from SERP.

A series of capacity building and enhancement programmes were conducted for dairy resource person, Village Dairy Functional committee at VO level, Management Committee at MMS level and executive committee at ZS level with the active support of resource persons from National Dairy Development Board (NDDB), APDDCF and subject matter experts. The training programmes included leadership skills, management skills and technical

skills with project exposure visit to AMUL Dairy in Anand (Milk Capital of India). As a part of capacity building, operation manuals and Standard Operating Procedures (SOP) were developed for efficient operation of milk procurement centre and BMCU. Similarly, the manuals on administrative and financial procedures along with sound booking system for both VO dairy functional committee and MMS Management committee were developed and introduced.

5.2 Technology Intervention

In the dairy intervention under Indira Kranthi Patham, a public sector agency was approached to develop an appropriate software and hardware equipment to meet the unique requirement of the dairy farmers, VOs and MMS. The technology was demand driven to meet the requirements of the payment transparency, appropriate business model, financial and economic sustainability and the institutional arrangement.

The key objectives to adopt the technology were -

- To build transparency and trust among the milk producers on milk procurement and payment by the milk procurement centres
- To reduce the pilferage in the entire milk supply chain
- To motivate rural farmers to supply quality milk
- To get the whole supply chain of milk under uninterrupted information flow network

Accordingly, two separate ICT systems were designed for VO and MMS. The Smart Data Processor Milk Collection Unit (SDP-MCU) was

installed in the milk procurement centre at VO level. It is an integrated unit, consisting of Smart Data Processor Electronic Milk Tester (SDP-EMT) with smart card drive, electronic weighing scale, digital indicator and dot matrix printer. It measures the weight and fat content and gives the printout of the transaction of the milk brought in by each producer. The member number, weight, fat and amount are displayed instantly and accurately on the SDP-EMT

and display board. The farmers while pouring milk can see in the display board. As the pricing is based on fat percentage, farmers have completely stopped the practice of adulterating the milk with water. These features have enhanced the trust of milk producers as the entire procurement and payment process is transparent. A shift end summary can be taken into a smart card for further processing of data at SAMCU at BMCU level.

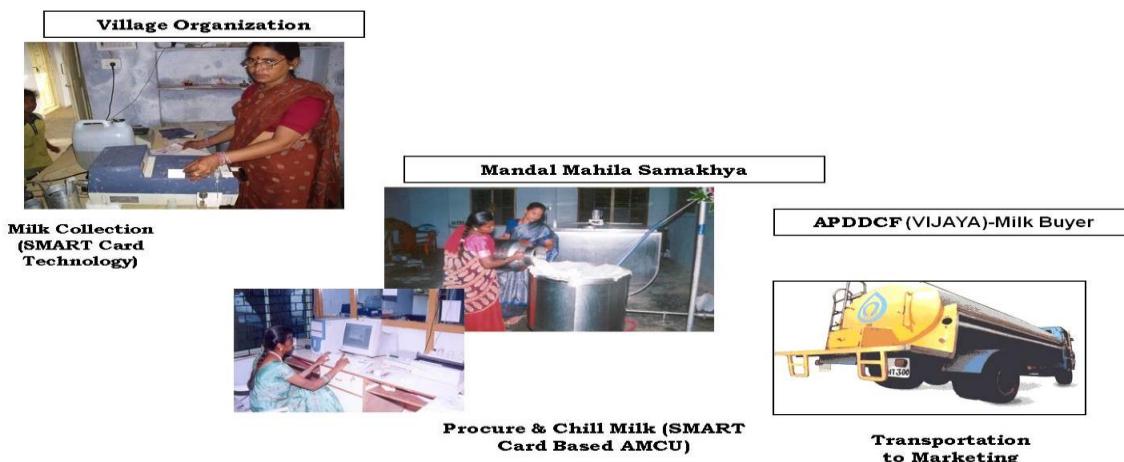


Figure 2 Partnership arrangement and ICT intervention in the programme

At BMCU level, Smart Automatic Milk Collection Unit (SAMCU) with Smart Card Reader/writer has been set up. The data at SAMCU can be processed for generating various reports. This SAMCU is a specially designed integrated unit which is a combination of several units like milk weighing system, electronic milk testing equipment, personal computer with printer and battery. It has also provision of uploading the shift wise milk procurement data of the milk procurement centre stored in the SMART Card. If the SMART Card data captured in the milk procurement centre do not match with the actual quality and fat percentage received at the BMCU level, there is likelihood of adulteration of the milk in the transit. Accordingly, this has also stopped the practice of adulteration of milk during transportation to BMCU. This raised the confidence of dairy farmers to supply pure quality of milk.

6. ENSURING EQUITY AND SUSTAINABILITY THROUGH ICT IN THE PROGRAMME

Sustainable livelihoods emphasizes on improving equity, by way of enhancement of capabilities, assets and access of the marginalized [Solesbury, 2003]. It

also includes an end to discrimination against the weaker sections of the society, deprivation and poverty [Chambers and Conway, 1992]. One of the most widely used terms, sustainability is used in various contexts like environment, economics, politics and social dimensions. The concept has been widely influenced by the sustainable development definition of Brundtland Report which states that "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" [United Nations General Assembly, 1987, p. 43]. The 2005 World Summit identified three pillars of sustainability i.e. economy, society and environment. In the context of sustainable livelihoods institutional sustainability is also considered as an important pillar. This includes sustainability of the community based organizations.

Studies have indicated that women play an important role in dairy development [Bock and Van der Burg, 2017]. Existing studies have also shown that women always participated in animal husbandry activities in addition to their daily household activities [Belurkar et al., 2003]. Majority of the dairy related activities are carried out by women and accordingly invest more time and energy when

compared to men. Notwithstanding, they generally stay undetectable workers [Chayal et al., 2009]. This programme with technology intervention has demonstrated the visibility of women member in dairy activities. This has acted as a tool for overcoming the barriers of caste, economic class and power.

6.1 Economic Empowerment

Economic empowerment of women is of paramount importance as standard of living and status in the society are adjudged on the basis of money. With this intervention, milk price at farmer's levels increased by more than 50 %. This has also lead to increase of average asset value by more than 30 %. It has reduced the need for constant borrowings from the village moneylenders for current consumption or current farming expenses. It also lead to increase of average household expenditures on food and education by 42 % and 204 % respectively. This decreased household expenditure on interest payments by 43%. This has reduced dependence on wage labour. Similarly distress migration from the rural areas decreased. This raised the status of women in the villages and strengthened the motivation for economic achievement. Prior to this programme, male members used to handle the procurement, selling of milk and cash income. Here the programme demonstrates the role of women in the collection and marketing of milk through technology and how women received the modest but regular cash incomes from dairying. This in turn influenced the women to be decision-makers for household food and nutrition choices.

6.2 Social Empowerment

Women farmers are now supplying milk to a common point i.e. milk procurement centre at VO level. This in turn resulted in gathering, more interaction and participation of women members. Participants reported that due to this they came to know each other in village, unnecessary misunderstanding and conflict in the community were resolved. There was cooperation among the women and other villagers which led to the healthy environment of a village as a whole. It also helped them to increase credibility of women among villagers and villages and gain more respect in their local communities. As a result of this activity, women had interaction with government officials which helped them in shedding off their hesitations.

At the milk procurement centres, they frequently talked about their issues, making a feeling of solidarity among them and delivering administration characteristics and leadership qualities. It helped them acquiring freedom of speech, mobility and involvement in decision making both in home and community as well. Milk procurement centres influenced various social issues and matters concerning women directly as well as indirectly. This programme was multi caste led with participation from all socio-economic levels in the village. This in turn helped them to break the barriers of society, participated in community as well as other community festivals, interacted with people outside family for social cause. The case demonstrates that the promotion of women participation into dairy value chains can be facilitated through technology and empower farmers economically and socially

6.3 Financial Sustainability of Community Based Organizations

A comprehensive micro-planning model was designed by SHGs and consolidated at MMS level to access the Community Investment Fund (CIF) under the programme for the capital investment required to install the software and hardware equipment for the milk collection system at VO and MMS level and the working capital required for the operating cost.

After analysis of the revenue, recurring expenditure, and capital investment, it has been estimated that from the first year of operation itself, both MMS and VO have started generating surplus after meeting operation expenditure from the service charge they receive from APPDCF and MMS respectively. Hence the community based organizations (CBOs) have became self sustainable financially.

6.4 Economic Sustainability

The technology suited to the need of business models of both forward linkage and backward linkage has contributed to the transparency and effective management of the system. The forward linkage has enabled the farmers to receive higher income and thereby it has influenced them to increase production with the support of better input and technical services through backward linkage established under the programme. This business model has motivated the farmers to take up the dairying activity more seriously to ensure a sustained income though dairying as livelihood. The supply chain with the provision of technology backed milk procurement, efficient supply chain system of CBOs and the strong milk processing and marketing

network of APDDCF has ensured the sustainability of the system. This has also enhanced the local economy as a whole.

6.5 Social Sustainability

Social sustainability encompasses people-centered approaches like human rights of disadvantaged sections of the society. It also includes issues pertaining to social welfare like education and health. The technology adopted under the programme ensured proper working conditions for the personnel deployed in the programme.

From the supply chain viewpoint, social sustainability includes trust and learning. With the transparency and reliability built under the system, it has ensured uninterrupted and assured milk supply to the buyer and transparent payment system. With higher milk production, consumption of milk has also increased leading to improvement in nutrition and health. Similarly with sustained and enhanced income, community's investment on children's education has increased. It has also empowered the women and led to inclusive and participatory development. Therefore, the current system and business model supports creating a healthy and happy community.

7. CONCLUSION

Studies have indicated that for dairy improvement endeavors to be compelling, the incorporation of the women farmer's voices is fundamental [Bock and Van der Burg 2017; Kabeer 2005; Perrons 2005]. A sustainable dairy based livelihood is possible only when the remunerative prices to the farmer, value to the consumer and reasonable returns to the value chain actors are guaranteed. Study also shows that dairying business can be sustainable with an efficient supply chain management and value addition [Rao et al., 2013].

The poor, without having formal education, learnt the art of milk collection and milk chilling by adopting ICT tools and milk chilling technology in the dairy intervention by SERP. They could come out of poverty through their own institutions and efforts of the sensitive support institutions for poor which induce and nurture social mobilization and their capabilities. ICT can act as catalyst for proper functioning of system and process laid out as a part of livelihood promotion through development of value chain system and improving market access to producers. Besides, technology can play a pivotal role in overcoming information

asymmetries, achieving equity in the society, increasing the efficiency and effectiveness of poverty reduction interventions and improving the ability to scale and replicate proven approach. The extent that human intent and capacity are put towards poverty reduction, technology can amplify that, and the combination will result in faster reduction of poverty. The innovative model of social mobilization, technology adoption and livelihood promotion in the two pilot mandals involving MMS and VO has shown a path to the rural women from low income households in the other parts of the state of Andhra Pradesh and Telengana. It has created a profitable situation for both milk producers as well the business house (APDDCF) ensured sustainable livelihoods for the rural poor. The critical success factors include simple and user-friendly technology, appropriate business model benefitting seller and buyer, committed and passionate programme leader, state support and community participation.

REFERENCES

- [1] I. Adewumi, O. E. Okunade, Contributions of ICT towards improving rural livelihoods in Oyo state, Nigeria, *Journal of Sustainable Development*, 13 (1), (2017), 54-59
- [2] N. Agha, B. S. Ghanghas, P. K. Chahal, Use of information and communication technologies by extension personnel to disseminate agricultural information, *International Journal of Current Microbiology and Applied Sciences*, 7(4), (2018), 1369-1376
- [3] H.El.Bilali, M.S. Allahyari., Transition towards sustainability in agriculture and food systems: role of information and communication technologies, *Information Processing in Agriculture*, 5(4), (2018), 456-464
- [4] O. T. Yekinni, et al., Benefits derived from the use of information and communication technologies among rural farmers in Northeast Nigeria, *Journal of Agricultural Extension*, 23(3), (2019),117-125
- [5] R. Duncombe, Using the livelihoods framework to analyze ICT applications for poverty reduction through microenterprise, *Information Technologies & International Development*, 3(3), (2006), 81-100
- [6] K. Lokeswari, A study of the use of ICT among rural farmers, *International Journal of*

- Communication Research, 6(3), (2016), 232-238
- [7] D. N. Makau, et al., Effectiveness of using cell phone technology as a dairy management training tool for smallholder dairy farms in Kenya, Livestock Research for Rural Development, 30(11), (2018), 195-201
- [8] F. Makoza, W. Chigona, The livelihood outcomes of ICT use in microenterprises: The case of South Africa, The Electronic Journal of Information Systems in Developing Countries, 53(1), (2012), 1-16
- [9] R. Syiem, S. Raj, Access and usage of ICTs for agriculture and rural development by the tribal farmers in Meghalaya state of North-East India, Agrárinformatika/Journal of Agricultural Informatics, 6 (3), (2015), 24-41
- [10] K. McNamara (Ed), Enhancing the livelihoods of the rural poor through ICT-A knowledge map, InfoDev Working Paper No. 14 , (2008), 1-38
- [11] S. O. Sennuga, J S. Conway, M.A. Sennuga, Impact of Information and Communication Technologies (ICTs) on agricultural productivity among smallholder farmers: Evidence from Sub-Saharan African communities, International Journal of Agricultural Extension and Rural Development Studies, 7(1), (2020), 27-43
- [12] C. Shirima, C. A. Sanga, Assessment of contribution of ICT for Sustainable Livelihoods in Kilosa District, Information Technology Integration for Socio-Economic Development. IGI Global, (2017), 260-283
- [13] A. F. Shaibu, Z. Hudu, M. Israel, Digital technology and rural livelihood- A study of peasant communities in Pru district, AGRIS online Papers in Economics and Informatics, 10(4), (2018), 71-78
- [14] C. Anadozie et al, The impact of mobile phone use on farmers' livelihoods in post-insurgency Northeast Nigeria, Information Development, 37(1), (2019), 6-20
- [15] I.S. Parmar, et al., Assessing farmers access to ICT and non-ICT sources for agricultural development in Semi-Arid Region in India, Journal of Agricultural Informatic, 9(2), (2018), 22-39
- [16] C. Wamala, Empowering women through ICT, Universitetsservice US-AB, (2012)
- [17] S Razavi, L. Turquet, Progress of the world's women 2015–2016: Transforming economies, realizing rights, Global Social Policy, 16(1), (2016), 86-93
- [18] K.K.P. Subashini, S. Fernando, Empowerment of farmers through ICT literacy, National Information Technology Conference (NITC), IEEE, (2017)
- [19] J. Ali, Factors affecting the adoption of information and communication technologies (ICTs) for farming decisions, Journal of Agricultural & Food Information, 13(1), (2012), 78-96
- [20] F. N. Mutui, et al., Agricultural technology and sustainable rural livelihoods among Makueni county residents, Kenya, Journal of Research Innovation and Implications in Education, 3 (1), (2019), 59-67
- [21] W.S. Kisan, A.S. Wadkar, K. Singh, Factors affecting the sustainability of ICT intervention for agricultural development-a review, Agricultural Reviews, 34(3), (2013), 198-206
- [22] A. Chib, J. Zhao, Sustainability of ICT interventions: Lessons from rural projects in China and India, in Communicating for social impact: Engaging communication theory, research, and pedagogy, (2009), 145-159
- [23] F. Ssozi-Mugarura, E. Blake, U. Rivett, Designing for sustainability: Involving communities in developing ICT interventions to support water resource management, IST-Africa Conference. IEEE, (2015)
- [24] S. Singh, S. Ahlawat, S. Sanwal, Role of ICT in Agriculture: Policy implications, Oriental Journal of Computer Science and Technology, 10 (3), (2017), 691-697
- [25] R. Heeks, ICTs and poverty eradication: Comparing economic, livelihoods and capabilities models, Development Informatics Working Paper No. 58, (2014), 1-38
- [26] A.K. Nanda, S. Samanta, Mainstreaming tribals through financial literacy – a review of literature, International Journal of Social Economics 45 (2)

- (2018) 437-444. <https://doi.org/10.1108/IJSE-12-2016-0371>
- [27] J. Farrington, et al., Sustainable livelihoods in practice: early applications of concepts in rural areas. London: Overseas Development Institute, 42,(1999)
- [28] R.Chambers, G.Conway, Sustainable rural livelihoods: practical concepts for the 21st century, Institute of Development Studies (UK), 1992
- [29] W. Solesbury, Sustainable livelihoods: A case study of the evolution of DFID policy, London: Overseas Development Institute, 2003
- [30] United Nations General Assembly, Report of the World Commission on Environment and Development: our common future, Oslo, Norway: United Nations General Assembly, Development and International Co-operation: Environment, (1987)
- [31] B.B. Bock, M. P. M. Van Der Burg, Gender and international development., Gender and rural globalisation. CABI International, 2017, 245-252
- [32] G.M. Bellurkar, P. K. Wakle, M. A. Gholve, A study on decision making pattern and participation of rural women in animal husbandry and dairying enterprise, Mah. J. Extn. Edn, 22(2), (2003),81-85
- [33] K. Chayal, B. L. Dhaka, R. L. Suwalka, Analysis of role performed by farm women in dairy farming, Indian journal of dairy science 62 (6), (2009), 491-494
- [34] N. Kabeer, Gender equality and women's empowerment: A critical analysis of the third millennium development goal 1,Gender &Development, 13(1), (2005), 13-24
- [35] D. Perrons, Gender mainstreaming and gender equality in the new (market) economy: An analysis of contradictions, Social Politics: International Studies in Gender, State & Society, 12(3), (2005), 389-411

Notes

ⁱMandal- It is an administrative division equivalent to Tehsil in Chattisgarh& Taluka in Gujarat and blocks in other states. It is a sub district of the area within a district.

ⁱⁱMandal Mahila Samakhya (MMS)- It is a federation of VOs at cluster (Mandal) level. A cluster of 15-20 VOs federate at Mandal level to form MMS.

ⁱⁱⁱZila Samakhya (ZS)- It is a federation of MMSs at district level. A cluster of MMS federate at the district level to form ZS.

^{iv} Andhra Pradesh Dairy Development cooperative federation Ltd (APDDCF) - Government supported Cooperative enterprise of farmers for Dairy Development with a three tier cooperative structure.

^vVillage Organisation (VO) - It is federations of self help groups (SHGs) at village level. About 8-10 Poor women form one SHG. 10-15 SHGs federate at village level to form an organisation called VO.

^{vi}Bulk Milk Cooling Unit (BMCU) - It comprises of a cooling tank with other accessories like weighing machine, Automatic Milk Collection Unit (AMCU) etc. The capacity of such BMCU varies from 500 to 10000 litres. This is used to chill the milk and store the raw milk without spoilage before processing.