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Social Impact Assessment of Agricultural Technologies with Special Reference to Sericulture Sector-A Review

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ABSTRACT: Technology uses resources, to produce other resources which affects and is affected by the society for over all development of the society. However, the investment of resources on technological development calls for assessment of the contributions of these technologies towards the development goals. Historically, researchers and extension workers have been mainly accountable for identifying and infusing economic and environmental factors into the process of agriculture technology development. In the same line R&D institutes of Central Silk Board have developed technologies ranging from soil to silk innovations, which are at various technology readiness levels (TRLs) and it is continuous process to meet the requirement of end users. But owing to climate change and increase in population, agriculture and allied sectors have been under high stress not only for producing food, fibre, maintaining environment but also providing social security and sustainable livelihood options to primary producers adding third point of social impact into the responsibilities of researchers and extension workers. However the socio economic studies in agriculture and allied sectors have mostly touched economic impact indicators like gross income, net income etc with very less focus on social impact indicators like education, recreation, food security, social networking, membership of social organizations, gender equality etc. Hence an attempt is made through this review to know the historical background of social impact assessment along with prioritising this assessment in development, research and outreach programmes of agriculture and allied sectors for sustainable long term impacts on the lives and livelihoods of farming community in India.

Keywords: Economic factors, Environmental factors, Social Impact, Social Security, Sustainable Livelihood, Primary producers.

INTRODUCTION

Research on agricultural technology evolves from the innovative ideas put forward to solve the felt and unfelt needs of farmers, within the institutional, financial and political context, keeping in view the economic, social, environmental impacts these technologies would have on social ecology of farmers (Sunding and Zilberman, 1999; Archer *et al*., 2008). However, the relationship between agricultural technology and its intended benefits on farmers is complex (Mendola, 2007), because efficiency and effectiveness of agricultural technologies is strongly linked to the asset base of beneficiaries *i.e*., human capital, social capital, environmental assets etc. (Temple *et al*., 2018) (Fig. 1). Human capital involves form of knowledge, skill, labour power *etc*. (Adato and Dick, 2002; Sima *et al.*, 2020). Social capital involves information, savings, lending and financial institutes, memberships of various social networks, social groups, solidarity and belonging, social ecological resilience (Claridge, 2020) and environmental assets include subsoil assets, land, forests, water etc.

On large scale farms, farm mechanization has increased the productivity and profitability of agriculture crops owing to better utilization of inputs and timeliness of operations (Verma, 2008). However, the full role of technological progress can only be realized in terms of economic, environmental and social growth (Robertson, 1981) (Fig. 2); when the use of new technology is widely disseminated and targeted on resource-poor producers in rural areas for maximizing direct poverty-alleviation effects (Mendola, 2007, Asfawa *et al*., 2012, Mariyono, 2019) as 70 % of the world's poor live in rural areas (Niak, 2017).

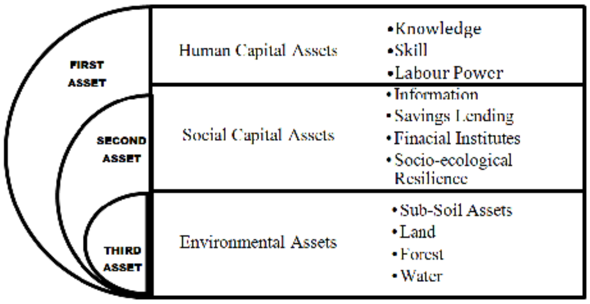

Fig. 1. Efficiency and effectiveness of agricultural technology is strongly linked to three asset of beneficiaries.

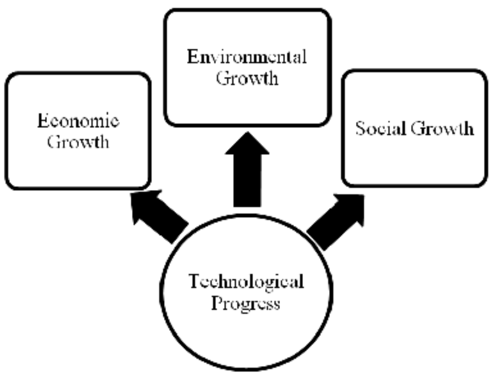

Fig. 2. Technological progress can only be realized in terms of economic growth, environmental growth and social growth.

For wide dissemination and targeting the improved technology, the technology must be accompanied by at least three complementary factors: an efficient inputs distribution system, an effective extension service and appropriate economic incentives (Morris and Doss, 1999; Feyisa, 2020; Biru *et al.*, 2020). Then direct and indirect effects of agricultural technologies can reduce the poverty (Kassie, 2018; Balzekiene *et al.*, 2008). Direct effects of agricultural technologies are considered as the gains for primary stakeholders (farmers). Indirect effects are the gains derived by secondary stakeholders (processing units) and tertiary stakeholders (consumers and government) owing to employment generation, lowering of food prices and its linkage effects (Harris *et al.*, 2001). But it is very difficult and complex to quantify and conceptualize these effects, because of difference in social, political, economic and environmental conditions of different regions of the world and multiple objectives of research like sustainability, food security, environmental protection, poverty etc. (Krishnamurty and Madhuri, 2017; Glover *et al.*, 2019). Yet it is needed in order to generate evidence for justifying investments in research and extension**,** refine the technologies and improve the socio-ecological resilience for sustainable development. (De Janvry *et al.*, 2011; Sharma and Singh, 2015; Wossen *et al.*, 2019). These effects can be categorised broadly into social, economic and environmental impacts.

Economic Impacts**:** Economic activities in a given area indicates the economic impact of a given technology and can be estimated in terms of lowering of production cost, output price, increase in gross income, increase in farm income, increase in farm profit, return on investment, economic surplus, value added *etc.* (Ward, 2014; Ma and Abdulai, 2017; Hanley *et al.*, 2012).

Environmental Impacts**:** The environmental impact of agriculture and allied sectors are the positive as well as negative effects *w.r.t.* farming operations cast on the ecosystems around them (Sawyer, 2008; Killebrew and Wolff, 2010). Positive impacts of agriculture (organic, sustainable) on environment includes bioremediation of polluted lands, eco-restoration of degraded lands, prevention of soil erosion, conservation of water table, air quality improvement by carbon sequestration, water cycle, nutrient cycle *etc* (Rohela *et al.*, 2020; Oleson, 2016). Negative impacts of agriculture (intensive) on environment includes, decrease in water table, contamination of ground water, decrease in species diversity *etc* (Çaglayan and Karadag, 2019).

Social Impacts**:** Social impact can be seen as the result of a complex and iterative process between four societal actors, science, government, industry and non-profit organizations which interrelate in the context of socio-economic development (Fuentes and Berg, 2013; Spaapen and Drooge, 2011). These can be understood only in social terms and not in technical terms (Russell *et al.*, 2010) and include consequences on ways of life, work, play, relationship, social networking, bonding, social organization, health, food quality and safety, recreation, animal welfare *etc* by any public or private action (Burdge and Vanclay, 1996; Burdge, 2003; Weisbrod and Weisbrod, 1997; Ozguven, 2018).

Origin of the Social Impact: Across the world, for many decades the social impact had been found in the form of philanthropic work. Traditionally social impacts were considered as side effects of technology, however the theory now reiterates social impacts are essential components of technologies and technological development processes. As such, social impacts can be understood not in technical terms but in social terms (Russell *et al.*, 2010; Ahmad *et al.*, 2011). While methodologies for environmental and economic impact assessments of technologies are well known but that of social impact assessments are still in developing stage (Rainock *et al.*, 2018).

Social issues were for the first time made part of definition of environment impact assessment during 1970's by the passage of NEPA (National Environmental Policy Act) in USA (Esteves *et al*, 2012). However, the strong interest in social impact assessment (SIA) came to the fore only after the report of the impact study conducted on environment in connection with Alaskan pipeline during 1973-1974 (Burdge, 2002).This lead to the work for the theoretical and methodological development of social impact studies. Then Mackenzie valley gas pipeline project (1974-1978) was the first case to be turned down by EIA (Environmental Impact Assessment) for non-compliance to the social issues of the local tribe. Since then, SIA has made progressive in-roads to different countries of the world (Berger, 1978; Hutchinson, 1985; Anderson *et al.*, 2008).

However till late 1980s there were not any specific principles and guidelines to conduct SIA in different countries of the world, therefore a committee was formed during late 80's (1989) to formulate guidelines and principles (G&P) for SIA, which came with its report in 1993-94 (Finsterbusch, 1995). Further improvement was felt to be made on G&P published in 1993-1994 at IAIA (International Association for Impact Assessment) conference in New Orleans, wherein decision was taken to revise published G&P by the formation of two committees. These committees came out with "International principles and the US principles and guidelines for social impact assessment in 2003" (IAIA, 2003). Outside USA other new related concepts developed over the period like third stream activities, sustainability assessment, corporate social responsibility, social risk assessment, triple bottom line accounting *etc* (Bornmann, 2013). But all these concepts were developed for big infrastructure projects. In this line social impact assessment in India was mandated in 2013 by the right to compensation and transparency in land, acquisition, rehabilitation and resettlement act (Kohli and Gupta, 2016). According to this law, any major project is required to conduct a social impact assessment within six months of the projects start date. However in agriculture and allied sectors, social impact have been a minor part of socio-economic studies without any distinct face as more and more impact through these studies is assessed in economic terms (Husen *et al*., 2017; Weibhuhn *et al.,* 2017) and social terms include only impact on risk orientation, innovativeness, mass media usage, knowledge, adoption, social organization, extension contacts ,social contact and social work (Prasad Babu *et al*., 2021) .

Process of Social Impact Assessment: SIA is a participatory process (Esteves *et al*., 2012) used in sharing and understanding the changes in human communities as a result of either an intentional or unintentional action. In case of agriculture development projects; the investors would like to know the prospective of their investments to achieve the desired impact (Jahan *et al*., 2013). Therefore SIA is for identification, scrutinization, evaluation, management and monitoring of both positive and negative social impacts of projects (Vanclay, 2003). Whereas the goal of SIA is to assist individuals, groups, communities, government organizations, NGO's, private organizations better understand and anticipate the possible social outcomes for human populations and communities of intended and unintended social change resulting from proposed projects, policies, programmes and plans (Burdge, 2002; Burdge and Vanclay, 1996).

Rationale for Social Impact Assessment of Developmental Programmes, Projects and Technologies: Despite increased interest from 1972 (United National Conference on Human Environment) in international social standards and commitments towards achieving the new sustainable development goals (SDGs) worldwide by 2030 and call for inclusive development (Gupta and Vegelin, 2016; Pradhan *et al*., 2017), absolute poverty and inequality has been increasing mostly in developing economies. It has been further aggravated by COVID-19 across the world by hitting all the sectors of economy *i.e*, agriculture, industry and services, thereby forcing 120 million additional people into poverty and decreasing the chances for achieving the goal of bringing global absolute poverty rate to less than 3 percent by 2030. (World Bank, 2020).

Further the donors, investors and research managers of developmental programmes, projects and technologies don't want to see impact in terms of economic benefits only but want to see change in terms of livelihood, wellbeing and environment in a sustainable manner (Kristjansona *et al*., 2002; Moghaddam and Far, 2019). Unfortunately, on social front till now the developmental projects particularly complex development projects have failed to address the direct and indirect impacts in an inclusive way (Smyth and Vanclay, 2017).

Hence, SIA conducted with core principles on social, economic and environmental sustainability can be used to improve the efficiency and output of developmental programmes, projects and technologies as these assessments have become inevitable when facing complex issues, projects, programmes, research etc (Aucamp and Lombard, 2018; Lee *et al*, 2020).

Commitment of India towards SDGs and Role of Agricultural and Allied Sectors. India is the sixth largest economy in the world. Owing to immense opportunities created by integration of technologies and innovations is aspiring to become $10 trillion economy by 2030 (Srivastava, 2018). Although contribution of agriculture towards national GDP is decreasing and number of farmers doing agriculture is declining, agriculture is still the main sector of employment in India as depicted in Table 1.

Table 1: Contribution of Different Sectors towards GDP in India.

Year	Percentage of total employment (%)		
	Agriculture	Industry	Services
2010	51.52	21.81	26.68
2011	49.26	23.10	27.64
2012	47.00	24.36	28.64
2013	46.50	24.37	29.13
2014	45.89	24.45	29.66
2015	45.26	24.54	30.2
2016	44.56	24.74	30.7
2017	43.93	24.86	31.21
2018	43.33	24.95	31.72
2019	42.60	25.12	32.28
2020	41.49	26.18	32.33

Source: World Bank

Further, there are strong commitments of Government of India towards achieving SDG (Sustainable Development Goals) by 2030 which require strong action in the following areas education, gender equality, poverty, water and sanitation, peace and justice, climate action, health and well-being, sustainable cities, energy, hunger, economic growth and decent work, ecosystems, consumption and production, reducing inequalities, infrastructure, partnership and industry and innovation (Choudhuri, 2019; David, 2018). In order to relish and remain committed to these areas some of the programmes in line with these areas have been launched like Jan Dhan Yojana (2014), Make in India (2014), Swachh Bharat (2014), Skill India (2015), Digital India (2015), Beti Bachao Beti Padhao (2015), Pradhan Mantri Ujjwala Yojana (2016), Ayushman Bharat Yojana (2018), Jal Jeevan Mission (2019), Pradhan Mantri Kisan Samman Nidhi (2019), so as to cater to the developmental action plan not only in economic terms but also in social and environmental terms, with "development with all, and for all," as a central slogan (Kedar, 2015; Arora and Chhadwani, 2018).

This commitment converges well with the ideology of social impacts of developmental programmes, technology in agriculture and allied sectors because social impacts ensures sustainable social ecology by harmonising environmental, cultural, social and economic components for better developmental outcome (Ekung and Effiong, 2014). As Prime Minister of India on SDG noted, "These goals reflect our evolving understanding of the social, economic and environmental linkages that define our lives."

Rationale for Social Impact Assessment in Sericulture in India: Sericulture in India has proved to be an ideal export earning industry (Table 2) and employment source particularly for rural poor by addressing equity distribution of income in line with the sustainable development goals (Dewangan *et al.*, 2011; Sharma and Kapoor, 2020; Halagundegowda *et al.*, 2021). It is one of the primary industry, providing gainful employment to more than 90 lakhs of Indians (Fig. 3). Central Silk Board through its research institutes is making continuous efforts in research and development in order to develop new technologies, techniques, innovation for providing gainful employment opportunities and improvement of living standards of sericulture stakeholders mainly farmers, reelers and weavers where in majority of task force involved is women folk (Khan *et al.*, 2016; Srinivasa Reddy, 2019; Bhat and Choure, 2014; Yadav, 2013).

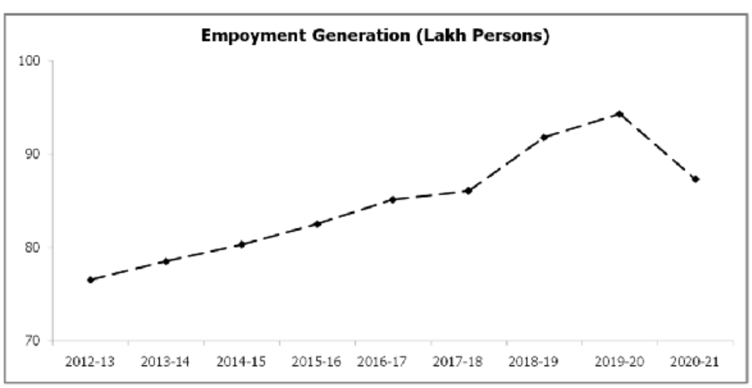

Fig. 3. Employment generation through sericulture (Partial data is represented for 2020-21).

Table 2: Export Earnings during 2010-11 to 2020-21 (In crores).

Year	Natural Silk Yarn	Silk Fabrics and made ups	Readymade garments	Silk carpet	Silk waste
2010-11	2123.21		683.31	21.10	36.14
2011-12	19.68	1497.97	765.83	20.08	49.77
2012-13	21.96	1410.31	787.15	21.14	62.97
2013-14	36.25	1455.63	874.00	15.71	99.30
2014-15	25.37	1465.40	1217.01	15.97	109.12
2015-16	30.31	1280.60	1078.39	16.88	89.80
2016-17	15.33	1051.65	864.33	63.78	98.33
2017-18	15.66	864.81	650.48	17.34	101.19
2018-19	24.72	1022.43	742.27	113.08	129.38
2019-20	16.77	982.91	504.23	143.43	98.31
2020-21	27.93	729.50	449.56	107.56	150.61

Source: Annual report, CSB (2010-2021) and Note on sericulture, 2013-2020

Different technologies have been developed by the Central Silk Board research institutes ranging from agronomic (soil) innovations to post cocoons (silk) innovations. Outreach and diffusion of these technologies has been carried (Khan *et al*., 2020; Balavenkatasubbaiah *et al*, 2015; Sudhakar *et al*., 2017), in a participatory manner with the help of respective state sericulture departments, community organizations, progressive farmers at grass root level. Although through these technologies, production of cocoons has increased (Ahmad *et al*., 2019) and the gap between domestic production and import of raw silk at national level has decreased as depicted in Table 3, but have these technologies reached the grassroots and helped the farmers in time saving, drudgery reduction, mulberry wealth creation, providing education to children, growing communication networks *i.e*., overall sustainable development of the sericultural families in addition to the increase in cocoon production and income.

Table 3: Raw Silk Production, Import of Raw and Import Value.

Year	Domestic Production (MT)	Import (MT)	Import value (Crore)
2010-11	20410	5820	927.59
2011-12	23060	5683	1111.53
2012-13	23679	4959	1238.56
2013-14	26480	3260	896.44
2014-15	28708	3489	970.82
2015-16	28523	3529	1006.16
2016-17	30348	3795	1092.26
2017-18	31906	3712	1218.14
2018-19	35468	2785	1041.35
2019-20	35820	3315	1149.32
2020-21	33770	1804	570.56

Source: Annual report, CSB 2010-20Note on sericulture, 2013-2020

Therefore in addition to increase in cocoon production, R&D approaches of CSB need to address all phases of technology life cycle; from conception, creation to commercialization and value creation (Kumar and Sinha, 2014; Rajesh, 2012; Wordofa *et al*., 2021). This would call for exemplar shifts in R&D planning and approaches during the current plan period (Nayak and Lokesha, 2019; Rajvanshi, 2016)**.** Further, the goal of providing more than 1 crore man days employment opportunities by the end of XII five year plan through sericulture would be realized only by strengthening and increasing the efficiency in R&D cycle keeping in focus farmers (landless, marginal and small) and societal priorities of the country (Ssemugenze *et al*., 2021).

Through the social impact studies on agricultural development programmes and technologies in general and sericulture technologies in particular, the information on societal indicators of the stakeholders at (individual family level, community level, regional level) like, education, gender equality, employment, ITK, networks and communication, stratification, social status, cultural identity/heritage , health and well-being, natural resources wealth, human rights etc could be generated in the sericulture sector. The data on these categories can be used as a base by the scientists, researchers of ICAR, Central Silk Board and other universities/ institutes in order to develop region and season specific technologies taking into consideration the social ecology of locality, community and the region (Rainock *et al*., 2018; Singh and Singh, 2008). Further, the information through these studies can be used by the donors, policy makers, governments to prioritize location specific developmental initiatives and refining of these initiatives as per local human and natural resources regularly.

CONCLUSION

Most of the stakeholders involved in sericulture are poor farmers and through this occupation they not only want to generate the livelihood for their sustenance but also want to have a progressive impact on the social life and wellbeing which includes education to their children, leisure time, social status *etc*. As the trend till know has been linear diffusion of technologies, top-down approach of developmental programmes without considering social impacts, thereby giving up and down results in cocoon production, quality of cocoons, market crashes resulting in farmers crop losses. Therefore crafting policies in sericulture R&D sector for more sustainability and equality requires inclusion of various costs, benefits and externalities of technologies and innovations, taking into account region and season specific cropping patterns, climatic conditions, technology transfer channels, local resources, social customs, stratification, traditions etc.

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