

Knowledge Intensive Agriculture for Attaining Sustainable Development Goals: Role of Indian Women

Prof. I. V. Malhan
Head, DLIS and Dean
SOMC&IS, CUHP, Dharamshala
H P, India
imalhan_47@rediffmail.com

Dr. Shivarama Rao K.
Assistant Librarian, CUK
Kasaragod
Kerala, India
shiva@cukerala.ac.in



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Abstract:

Agriculture is sin-qua-non to core Sustainable Development Goals (SDGs). Any efforts for enhancing agriculture productivity, improving the lot of farmers and adopting sustainable agricultural practices provide a natural push for attaining SDGs. However, government agricultural policies, agricultural reforms and amelioration of the agricultural activities must benefit the farmers. The Government of India thus set up a panel on doubling farmers' income by the year 2022. Agriculture reforms such as reducing cost of cultivation, enhancing productivity and profit centric approaches are on the anvil. Indian agriculture is also facing several problems such as climate change, soil degradation and lowering of ground water levels at some areas, increasing cost of agricultural inputs, storage and marketing of agricultural produce and growing number of small and marginal farmers. In spite of agricultural subsidies, free electric power supply at some places, waiving of farmers' loans, enormous infrastructure for agriculture research, incidences of farmers committing suicides are sometimes heard. To meet the triple challenges of increasing agricultural productivity, enhancing farmers' income and pursuing sustainable agricultural practices, knowledge sharing is essential. Though woman agricultural workers are by and large involved in agricultural chores such as paddy planting, harvesting of tea leaves and cotton crop and food processing at home, their engagement at higher level of crop planning, their capacity building for knowledge intensive agriculture will make available more talent, creativity and knowledge for agricultural pursuits. Adopting the case analysis, exploratory, descriptive and observational methods of research, this paper portrays some cases where enhanced women participation of educated women in agricultural pursuits led to better agricultural productivity and enhanced farmers' income. Presents a study of select rural areas depicting problems of women participation in knowledge intensive agricultural practices and suggests measures for their greater involvement in agricultural work to improve agricultural productivity and enhance agriculture based income.

Introduction

Sustainable development goals (SDGs) are a blue print and a roadmap for alleviating poverty, improving living conditions and protecting the planet earth. Majority of the population in developing countries is engaged in agriculture and is instrumental in food and nutritional security of their nations. Any initiatives for enhancing agricultural productivity, capacity building of farmers, improving their economic lot, and adopting sustainable agricultural technologies and practices leads to a natural push for SDGs. These nations therefore may revisit their agricultural policies, focusing on sustainable agricultural productivity ameliorating agricultural practices encouraging knowledge intensive agricultural activities and ensuring that development of agricultural sector and improvement of economic lot of farmers must go hand in hand. The Government of India therefore set up a panel on doubling farmers' income by the year 2022. Agricultural reforms such as reducing cost of cultivation, enhancing productivity, improving profitability, encouraging organic farming are in the pipeline. Doubling the farmers' income in a given timeframe is a huge task as Indian agriculture is also beset with several problems such as climate change, soil degradation and lowering of water level at some areas, increasing cost of agricultural inputs and growing numbers of small and marginal farmers with growth of population. In such a situation where overcoming the ongoing farming problems is also an issue, enhancing agricultural productivity and improving the farmers' income is a double challenge. It cannot be achieved without reaching up to the level of every farmer analyzing how do he/she is doing farming and what more can be done to improve his/her farming ways and agricultural related income through knowledge interventions and training. We must not ignore the fact that our agriculture growth and productivity is a combined balance sheet of contribution of all of our farmers.

Agriculture plays a pivotal role in SDGs, as food security, overcoming the problems of hunger and poverty alleviation is closely linked to it. Given that 78% of the world's poor are heavily dependent on agriculture not only for their food, but also for their livelihoods, agricultural development, including the growth of agricultural productivity and incomes, represents one of the most powerful tools that exists to end extreme poverty (World Bank, 2015). Many poor farmers are growers of food crops but not adequate consumers of it. The problems of the existing numbers of undernourished people are further aggravated by the growth of population. According to FAO, by 2042, the world will have nine billion mouths to feed, India alone accounting for 1.65 billion of those. If we want to avoid mass deprivation, that is, malnutrition at one end of the scale or outright starvation at the other, we need to increase food production by 70 percent (Jishnu, 2017). In India agriculture plays a vital role in nation' economy. India's 54.6 percent of the population is engaged in agriculture and allied activities (census, 2011). As per the provisional estimates released by the Central Statistical Office (CSO) on 31st May, 2016, the agriculture and allied sector contributed approximately 17 % of India' Gross Value (GVA) at current prices during 2015-16.

In spite of the enormous government support for agricultural, existing of models of best practices, agricultural research stations demonstrating higher yields, enormous infrastructure for agricultural research, agricultural subsidies, free electric power supply for agriculture at some places, waiving of farmers' bank loans, incidences of some farmers not coping up with their problems are often heard. There are thus also some neglected dimensions in Indian agriculture. A large number of farmers in India neither have access to latest beneficial agricultural information nor are they trained in latest knowledge intensive agricultural methods. Many of them are thus not able to do and accomplish the best from their existing

resources. They are also not aware of the extent of environmental and soil damage done by some of their agricultural practices. For instance farmers burn paddy stubble which they set on fire to save labour in spite of the fact that paddy stubble cutter machines are available. A National Sample Survey report based on data collected spanning July 2012 to June 2013 indicates that farmers continue to remain far removed from new technologies and guidance from state run research institutes. Over 59% of the farm households received no assistance from either government or private extension services. Of the 40.6 households who received extension assistance, only 11% came from physical government machinery-extension agents, Krishi Vaghyan Kendras and agricultural universities. More farmers depended on other farmers(20%), media including radio, TV, newspapers (19.6%), and private commercial agents (7.4%) (Bera, Sayantan, 2017).

A massive effort is required for training and capacity building of farmers and showing them the way of how to do their work in a better way, give their best and earn more from their existing agricultural and allied resources. Even one or two days mass training of farmers organized in every village will not only motivate the farmers but also help them in informed decision making pertaining to agricultural issues and will have a ripple effect on agricultural productivity. If sincere efforts are made in training and facilitating farmers for adopting best practices according to their geographical area and situations and farmers are encouraged for knowledge intensive agriculture, the nation need not have to face the huge burden of waiving of farmers' loans and the same money can be used in improving irrigation, controlling floods and drought conditions. Though farmers' illiteracy still remains a major impediment in transfer of knowledge, mobile telecommunications has improved the communication environment. Merely transfer of information is however not enough, making them understand how to do their work and enhance productivity by demonstration can put the knowledge to desired action.

Another important concern in agriculture is the gender issue particularly recognition of women's contribution to agriculture. Women farmers produce 20-30% less than their male counterparts, mostly due to differences in their access and use of resources. Women produce over half of the food worldwide, so bridging this gap could reduce global hunger by as much as 17% (Farming First, 2015). Women play a crucial role in agricultural and rural economy. From paddy planting to harvesting of tea and cotton crops to food processing, cooking and child care at home, women are contributing a lot to human labour intensive chores but their contributions are seldom noticed and recognized. "Women are almost half of the adult population. They constitute one third of labour force but consume two third of the world's working hours and yet earn one tenth of the income and own only one percent of the world is property (Varma, Shashi Kanta, 1992).

Social taboos, social traditions, cultural concerns often restrict them in some situations to contribute their best. In several cases they self withdraw for example in planning and decision making pertaining to agriculture several of them may simply say it is the domain of men and they should do it. Gender wage gap across rural and urban, agricultural and non-agricultural jobs, regular and casual employment need attention. Even trade agreements are not gender neutral and that differential impact of trade policies on gender exists, especially for women working in agriculture, food processing and textiles (Ministry of Women and Child Development, 2016). As gender equity is an important concern for sustainable agriculture, efforts are needed to support women farmers in their livelihood, their visibility and identity, securing their rights over resources, ensuring entitlements and provision for social protection.

Government of India initiatives

The government of India took several initiatives for empowering the women as well as improving the state of affairs of agriculture. For instance Rs 11,000 crores has been deposited in more than 1 crore accounts to ensure bright future of daughters. Thirty lakh jobs are being provided to the women in the textile industry. More than 2 crore economically weaker women are given gas connections. Out of the 7.5 crore loans sanctioned under Mudra Yagna, 70% was for women (Empowered Women,2017). Recently, Govt. of India has directed to all its states to spend 30 per cent of funds allocated towards farm schemes for empowering women farmers, whose share is significant in the country's agri workforce. Nonetheless, Govt. has made mandatory to deploy one female scientist in 668 Krishi Vigyan Kendras (farm science centres) spread across India. So far 3.1 lakh female agriculturists have been trained in 2016-17 fiscal by these kendras. A gender knowledge portal has been developed for women farmers. Central institute for women in agriculture in Bhubneshwar has also been set up for women farmers by the Indian Council of Agricultural Research (The Economic Times, 2017). Under govt.'s Mahatma Gandhi National Rural Gurantee Act (MGNREGA) which guarantees 100 days of wage-employment in a year to a rural household, several poor women farmers have benefitted from the scheme.

India had a system where a farmer is required to sell his farm produce in local village market called 'mandi'. These mandis are under the control of local influential class who used to corner most of the profits from sale of the produce and a small portion being received by farmers. In India, there have been several initiatives by State and Central Governments to meet the various challenges facing the agriculture sector in the country. Recently, in a major transformation which is going to benefit hundreds of millions of farmers in the country and which disrupts this stranglehold of local mandis, govt. have created a eNational Agricultural Mandi, unifying 250 mandis into a single national portal.

In the recent budget (Vikaska budget) of government of India the main slogan was prosperous farmers and profitable agriculture and from food security to income security. The budget has lot of innovative initiatives such as Prime Minister's Krishi Sinchai Yojana – irrigating 28.5 lakh hectares of land, long term irrigation fund in NABARD, soil health card scheme to cover all 14 crore farm holdings, unified agricultural marketing e-platform for wholesale marketing, to mitigate risk in agriculture sector Prime Minister's crop insurance scheme, to support organic farming through Paramparagat Krishi Vikas Yojana (PKVY) etc. Government has made many initiatives in the budget, in comparison to the budget last year. In this budget of year 2017-18, the fund for rural, agriculture and allied sectors has been increased by 24%. As such, agriculture is state subject in India, so State Agriculture Ministers have an important role in its progress.

The Cabinet Committee on Economic Affairs (CCEA) (Srinivasan, 2016) has approved Blue Revolution in India. It's an integrated scheme designed to increase the productivity and profitability from aquaculture and fisheries resources, inclusive of both inland and marine. With a budget of Rs 3,000 crore offered by the government for the next five years, this scheme aims to maintain an annual growth rate of six to eight percent of the agriculture and allied sector. India boasts of being the largest producer of milk in the world with an annual output of 130 million tonnes. However, with a milk-producing animal population of more than 118 million, the milk yields per animal is very low. To meet the steadily growing demand for milk, the National Dairy Development Board (NDDB) has announced 42 dairy projects, under a budget of 221 crore.

Digital empowerment of people, especially in rural areas and weaker sections, is a key strategy which has enabled faster adoption of digital technologies. An Indian National Digital Literacy Mission is being implemented and over 8 million people have been trained in two years. Govt. is in process of expanding this programme to over 60 million persons. As part of the drive to promote digital payments, over 20 million people have been trained in about 6 weeks. Govt. is going to launch a new programme entitled Digi-Gaon (Digital Village), which ensure availability of education, health, skilling and public wifi in villages where broadband connectivity has reached. The programme will help provide basic social facilities to villages (Kumar, 2017). Recently; the Indian union cabinet has approved 'Pradhan Mantri Gramin Digital Saksharta Abhiyan' (PMGDISHA) to make 6 crore rural households digitally literate. This is expected to be one of the largest digital literacy programmes in the world.

Due to Govt.'s push for more and more e-governance, which has resulted in transparency and governance through IT has empowered the citizens. Successful implementation of e-governance in the areas like- maintaining land records is a great step in removing the malpractices and creating assurance of rightful ownership. Aadhar (Unique-identity number issued to all Indian residents based on their biometric and demographic data) is another such tool, which has empowered the masses by confirming their identities and is good example of ICT solution attempting to provide access to monetary benefits by establishing the correct identity and this way rural economy is also expanding. Market expansion with the help of ICT can be seen through various examples, such as women's livelihood is being facilitated amongst the weavers' community in the north eastern states of India by marketing their product through the internet medium. Indian rural market is going under transformation with better access to information (Lekshman, n. d). With the help of IT, farmers can use the services of Forward Markets Commission (FMC) and can get better value for their product. FMC is the chief regulator of commodity futures markets in India.

According to an article by The Hindu (Rukmini, 2016), the average recovery rate of the investments made by Indian farmer is only 30 percent. With all such statistics India has several shining examples of what a community can do when it comes together for a better tomorrow. For example, an obscure village in the foothills of Melghat region of Amravati district in Maharashtra, Payvahir, has set an example for the country by consistently showing how communities and NGOs can work together to conserve the environment and ensure sustainable livelihood for people. In 2014, Payvahir bagged the Biodiversity Award from the United Nation's Development Programme for turning a barren, 182-hectare land under community forest right, into a forest. Recently, the village also came up with an out-of-the-box idea of selling organic custard apples and mangoes in Mumbai under their brand Naturals Melghat (Pal, 2016).

Recognizing the vital role that ICTs can play in the empowerment of the rural women, a scheme has been launched as pilot project with the aim of facilitating women's Self Help Groups (SHGs) access to ICT enabled services. The Sanchar Shakti pilot scheme for Mobile Value Added Services (VAS) provisioning envisages development of content/information customized to the requirements of women SHG members engaged in diverse activities in rural areas across India. The scheme entails innovative application of technology in designing and delivering the VAS content so as to ensure its easier accessibility and effective assimilation among the targeted women beneficiaries (USOF).

Unique Cases of Women in Indian Agriculture

The scenario of agriculture has completely changed with change in time but from centuries one thing that didn't change is considering women as key labour in this industry. Women form the backbone of agriculture in India and association of women in agriculture is an age-old practice. In developing countries like India, agriculture continues to absorb and employ female work force but fails to give them recognition of employed/hired labour. Women constituted 38% of the agricultural labour force in developing countries. It is also estimated that 45.3% of the agricultural labour force consists of women. But a large number of women have remained as "invisible workers" (Ghosh & Ghosh, 2014). Comprising the majority of agricultural laborers, women have been putting in labour not only in terms of physical input but also in terms of quality and efficiency. Over the years, there is a gradual realization of the key role of women in agricultural development and their contribution in the field of agriculture, food security, horticulture, dairy, nutrition, sericulture, fisheries, and other allied sectors. There are several areas where women farmer need attention. A report by the charity Oxfam released in January records that more than 40 percent of 400 million women living in rural India - a third of India's 1.2 billion population - work in agriculture and as per official data women make up more than a third of India's agriculture workforce... (Goldsmith, 2017).

Empowerment through Skill Development and Knowledge Transfer: The focus and emphasis now required is towards skill based development in rural areas for higher farm productivity, profitability and employability. Workforce will turn into a human resource only when workers are skilled. Govt. rightly believes that for a sustainable growth rate of ten percent and development at the bottom of the pyramid, focus must be on skill development. So, a new ministry was formed which was devoted to Skill Development and Entrepreneurship. Women farmers need to be imparted with major skills to deal knowledge intensive agriculture. They need to be trained in areas like field operations, conservation of bio-diversity, nutritional bio-security, vocational trainings and organic farming. A growing number of women are being trained to take charge of some of the millions of small holder farms across India where about 70% of agricultural work is done by women but with little recognition of their input.

Acknowledging the growing role women play in India's key agricultural sector, state governments, farming groups, and private industry are starting to train women to lead farms, teaching them about crops, irrigation, and finance. For instance, Kanjarya, 36 years old women from Mayapur in the western state Gujarat, is one of a growing number of women being trained to take charge of some of the millions of small holder farms across India. She is being trained to grow sustainable cotton and run her farm as a business in a project by social enterprise Cotton Connect and India's Self Employed Women's Association (SEWA) funded by British retailer Primark. Due to this, she had doubled her cotton yields while lowering her costs in three years - and the extra income changed their lives (Goldsmith, 2017). By creating linkages with knowledge and information flow amongst women farmers, socio economic progress can be achieved and self employment can be encouraged. A semi - literate, daily wage earner Lalmuni Devi of Azadnagar village of Patna district, now figures in the list of top 25 Asian farmers following her adoption of mushroom farming under the guidance of ICAR. According of Lalmuni, turning point in her new profession came when a group of instructors from ICAR taught her the skills to grow mushrooms. This method thought by ICAR instructors convinced her that it did not require much land. She has inspired 22 other women in her village to take up mushroom cultivation (Dutta, 2007). Educated Indian women

are also venturing into areas like organic farming. For instance, Likitha Bhanu, a biotechnology engineer founded Terra Greens Organic at the age of 22. Today Terra Greens has 4000 farmers from Maharashtra, Rajasthan, Tamil Nadu, Karnataka and Telengana working for them and products are distributed in 600 major stores in India. With a turnover of Rs 150 million this year, Likitha plans to expand to 10,000 farmers by the end of this year... (Warrier, 2017).

A FAO (Food and Agriculture Organization) report says that if women were given equal access to resources as men, agricultural yield could increase 2.5-4% in developing countries, enough to feed at least 100 million more undernourished people! (Pal, 2016). It has also been observed that been given a free hand, women farmers are generally are more tempted to adopt integrated farming, expand their farming activities, increase farm incomes, extend help to other farmers, find solutions to problems and take adequate notice of environment issues. A self-sufficient farmer Rita Kamila who has achieved a sustainable source of livelihood in one of the world's top climate change hotspots, the Sunderbans. Rita has successfully transitioned her farm to organic over the past few years and now grows several varieties of food crops. Using the ecologically sound practices of integrated farming, she has incorporated livestock and fish culture into her farm. She has also installed a bio-digester plant that generates bio gas from farm waste such as livestock manure and fish waste. The biogas is used as cooking fuel and the residue is judiciously recycled to provide nutrients to crops (Pal, 2016). A 37-year-old Padma Bai was a tribal Girijan farmer who only cultivated cotton, oil seeds and pulses on her three acre land. With the support of a Fairtrade India, a certified producer organisation, she invested in drudgery reducing farming tools such as pick-axes, sickle, spades, hoes and wheelbarrows. Her idea was to lend these tools to poor farmers in neighbouring villages who could not afford them, at a marginal rate, through her hiring centre (Pal, 2016).

Women farmers of the Medak District of Telangana state are teaching sustainable rain-fed farming techniques to peasants in the neighbouring Vidarbha region of Maharashtra. Representing the poorest of the poor in their village communities, these women farmers were once landless laborers, but today, due to the help of Deccan Development Society (DDS) village level women's sanghams (voluntary farmer associations), these women have not only tackled their farming problems effectively but are also generating an additional income through innovative and eco-friendly ways. On their month-long seed bartering journey to 30 villages in the region, Chandamma and her team teach other villagers on organic farming methods and growing climate-resistant crops like traditional varieties of millets. Many of them are illiterate and have become filmmakers who have produced documentaries on organic farming, seed sovereignty, bio-fertilisers and good farming practices that have been screened worldwide. Nonetheless, they have also launched the Sangham community radio, the first-of-its-kind in India, which is another great initiative that educates farmers in a staggering 200 villages in the region (Pal, 2016).

A small village in Nagaland's Phek district, Chizami has been scripting a quiet revolution in terms of socioeconomic reforms and environmental protection for almost a decade. A model village in the Naga society, Chizami is today visited by youth from Kohima and neighbouring villages for internships in the Chizami model of development. What is unique in the Chizami model of development is that marginalized women have played an important role in bringing about this socio-economic and sustainable transformation that is rooted in traditional practices of the state (Pal, 2016). Empowering women with upgraded

skills and transfer of worthwhile knowledge is necessary to draw women into mainstream agriculture.

There are stories of women farmers who found solution for crop diseases where Scientists couldn't do anything to save Crops. Whitefly pest attacks, which destroy cotton crops, have always been an issue in Punjab and Haryana. After many failed attempts by scientists and governments to find a solution, a group of women in Haryana has finally found out a way to protect the crops. And state agriculture department officials claim that farmers from over 12 villages in Jind have adopted pesticide-free style of farming leading to limited impact of whitefly attack in more than 1,000 acres of land. Instead of using chemicals and pesticides, the farmers use a homemade spray to strengthen the plants. Their spray is a mix of di-ammonia phosphate (DAP), urea, zinc and water, and is called 'Dr Dalal solution'. It is named after an agriculture development officer (ADO) named Surender Singh Dalal who started this style of farming about eight years back in Jind. Instead of spending about Rs 5,000 per acre to control whitefly, they now just invest about Rs 500 per acre (Pareek, 2015).

Technology development for women: Agricultural development mainly relies on technology transfer and usage. As technologies are context based and situational, designing of women friendly tools and customization according to local conditions is necessary, may it be for field operations, animal husbandry or for generating side incomes like mushroom cultivation, floriculture etc. Technology offers solutions to many challenges faced by rural women including labour-saving technologies related to domestic and productive work such as solar water pumps and community water schemes, improved cooking technologies, transport of water, wood and crops, post-harvest and food processing. However, in India the poor women farmers by and large continue to use labor-intensive technologies and methods or use no technologies at all. Technology adoption rates of male and female farmers are impacted by the different conditions under which they operate, including access to resources, secure land tenure, etc. (Rathgeber, 2011). For example, a study of male and female farmers in Malawi depicts that woman farmers were quicker to adopt a new kalmia bean variety because it had qualities that they valued, such as a shorter cooking time and a good taste. In a study conducted in India, attitudes of men and women towards the adoption of groundnut production technology differed along gender lines. While men were mostly concerned about financial viability of the technology, women perceived the advantage of the new technology options in terms of workability and implications for drudgery and occupational hazards (Padmaja & Bantilan, 2008). Mechanization of agriculture is becoming increasingly common, especially in Asia region, however women are often prohibited from using such machinery because of prevailing cultural practices, this has adversely effected into job loss (Rathgeber, 2011).

Convergence of Information Communication Technologies (ICTs) along with farming technologies has enhanced the agricultural value chain and productivity. E-agriculture is an example for convergence of IT and farming techniques. This has helped in access to price information, access to agriculture information, access to national and international markets, increasing production efficiency and created a 'conducive policy environment'. One of the best examples for use of IT in farming is being done by one vegetable farmer in Hyderabad using webcams to monitor the crops and to take the scientists' expertise to address problems without taking them to the field (Lekshman, n. d). Through ICTs farmers are now able to take quick decisions and better planning by using software which can keep better track of crops, predict yields, when to best plant and what to plant etc. Community involvement in

agriculture has got boost and several IT applications helped farmers in building and sharing information.

IT-savvy farmer A V Narayanaswamy from Waynad district of Kerala gathered and created 2 lakhs of Webpages database on agriculture. Simultaneously he learned different programming languages and software packages to put the information in proper order. This 55 year old farmer is a pioneer in enabling farmers to become farming entrepreneurs; his own life is a reflection of that pioneering way. The family does collective farming of resources for the database. While his wife Prabha does the data processing, son Vishnu does html and scripts and his daughter Veda does graphics and mail. Armed with the latest information on the tricks of the trade, Narayanaswamy is preparing the farmers of Kerala to take on the world (Talent Kerala, 2003).

Creation and participation in self-help groups: Self-help groups are important for getting financial support and generation of employment. There are negligible numbers of women cooperatives in India and this need to be strengthened by providing financial help to them. At present there are only 20,014 out of the total 8 lakh in India (Economic Times, 2017). Women farmers must be trained in micro-managing of finance, business and marketing. One of the finest examples for the women empowerment is 'Kudumbashree' of Kerala state. Launched by the Govt. of Kerala in 1998 for wiping out absolute poverty from the State through concerted community action under the leadership of Local Self Governments, Kudumbashree is today one of the largest women-empowering projects in the country. The programme has 41 lakh members and covers more than 50% of the households in Kerala. Built around three critical components, credit, entrepreneurship and empowerment, the Kudumbashree initiative has today succeeded in addressing the basic needs of the less privileged women, thus providing them a more dignified life and a better future. Literal meaning of Kudumbashree is prosperity (Shree) of family (Kudumbam). The Kudumbashree network by March 2017 had 2,77,175 Neighbourhood Groups affiliated to 19,854 Area Development Societies and 1073 Community Development Societies with a total membership of 43,06,976 women. Kudumbashree membership is open to all adult women, limited to one membership per family. It is arguably one of the largest women's networks in the world (Kudumbashree). Nonetheless these self-help groups are effective in disseminating information, building a sense of shared purpose, and enabling cooperative action in sustainable natural resources management and development.

Managing climate change and environmental resources: There are hundreds of examples of women farmers across India who are helping several poor families adapt better to climate change. As Sursati from village Janakpur, district Gorakhpur in Uttar Pradesh, explains, "Earlier, we could not produce enough food for a year because our village would get waterlogged by the flood waters. Now, using early maturing paddy varieties and organic manure to revive soil fertility, we can at least eat for all 12 months from the same piece of land." Sursati was helped by a local NGO, Gorakhpur Environmental Action Group (GEAG), in the flood-prone areas of eastern Uttar Pradesh (UP), where climate vagaries have been impacting agricultural production for some years now. Women farmers like Kamlavati, from village Janakpur, who now train other women in adaptation techniques and acts as a trainer at Govt.'s Farmer Field Schools (Kapoor, 2013).

Agricultural extension: Agricultural extension continues to play a key role in technology dissemination and recently these models have moved towards participatory methods and adopting Information Communication Technologies (ICTs). However, several

studies show that there is considerable gender bias in national level extension systems. For example, research with rice farmers in South and Southeast Asia found that most extension agents interacted only with men so women did not receive important information and were unable to take advantage of opportunities such as the chance to earn income from renting out drum seeders (IFAD). Responsiveness must be there to ensure the availability of extension services offered by various line departments to women farmers.

Efforts need to be made to utilize skills and capacities of successful women farmers as last mile extension workers as an extension to agriculture extension. Although Internet penetration is gaining momentum in India, the usage of the Internet amongst women in India was lower than that in most countries in the world. In rural India only one in ten Internet users is a woman. For example, Google India (Gallant, 2017), in partnership with Tata Trusts, has initiated Internet Saathi (Internet Friend) programmes working to make that belief a reality, specifically for India's rural, less technologically educated women. The Internet Saathis are akin to the village postman, who is the single-point contact between the village and the outside world, in terms of information as well as communication. Trained by Google, these saathis are roving educators and activists who travel to villages, armed with smart phones and tablets. One among the Internet saathi Chadha shared the story of Chetna, who lives in the Alwar district of Rajasthan who joined the program in Dec 2015. "Chetna not only learned about mustard farming techniques to run her farm, but her own experience also inspired her to train over 500 girls and women in a span of four months". This domino effect is a perfect example of reinvention, of sensing opportunities and preparing our farmers ahead of time.

TechnoServe organization, with financial support from the Bill & Melinda Gates Foundation (BMGF), has implemented the Women Economic Empowerment project in collaboration with the Government of Bihar's JEEViKA program. The project is providing technical assistance to the producer groups (PG) and developing a multi-year roadmap to facilitate PG formation in the state of Bihar. Supported by the World Bank, JEEViKA aims to alleviate poverty in rural Bihar through value chain-based livelihood interventions and the support of community-based organizations. The members of the producer company are enthusiastic about the results. Due to this, they are now getting better prices compared to the traditional model of selling to village-level intermediaries. By the end of January 2017, 122 members of 15 producer groups across six villages directly benefited from this initiative, experienced a 9 percent increase in income in addition to sharing in SJMKPCL's (farmer producer organization (FPO) comprised of smaller producer groups) profits. Timely payment and cashless transactions are a key benefit of the intervention. Women farmer members receive payments through digital transfers directly into their individual bank accounts (Technoserve, 2017). In an effort to empower rural India with tech intervention; recently ICICI Bank has digitized 100 villages in 100 days, and dedicated this achievement to the nation.

Special interventions for women farmers

In this fast changing hyper competitive world, the women farmers are also becoming information savvy and their information requirements are increasing constantly. The very nature of agricultural knowledge is changing rapidly; it is obvious that the development of agriculture is highly dependent on the new knowledge and information. Hence, the technology along with know-how is essential for sustainable agriculture production. Empowering women farmers with customized extension and trainings should not only be as

beneficiaries but also as change agents for higher adoption and diffusion of latest home and farm technologies. For example, an important initiative towards economic empowerment is Mahila e-Haat which is an online marketing platform for women entrepreneurs and self-help groups (SHGs). The e-haat was launched as a tool of ensuring financial inclusion of women entrepreneurs.

There is an urgent need of conducting need based and well-focused trainings and mass awareness programmes for women farmers using modern ICT tools. The Govt. should proactively implement developmental plans and effective extension strategies to bridge the knowledge gaps between the research stations and the women farmers. Approaching sustainable growth in agricultural sector is not possible without effective communication process with women farmers in a language they can understand. Communication has long since been recognized as a tool for development. In agriculture gaps in transmission of information and sharing of knowledge have been identified as hurdles in not just formulating policies for development but also in the implementation of welfare measures and ensuring their reach to intended beneficiaries. To enable the population at the grassroots to know about new developments, to access knowledge, to learn ways to utilize it for their own good, media is essential. It becomes important to protect the rights of the women farmers to get information and enable utilizing it. For example, TV has been a mega source in mass education on the benefits of safe health and hygiene habits. Access to TV has opened up a whole new world to information which was not available before. TV educates the masses on better farm practices and locally made cheaper options for many agricultural inputs.

Lack of flow of information, lack of streamlined communication channels can have major ramification. Lack of appropriate communication structures, methodologies and tools results in poor identification of rural women farmers needs and priorities getting shifted to irrelevant areas. Mainstream media augmented with latest social media platforms has boosted inclusive development process. Identifying unique success stories of women farmers and documenting such knowledge for wider dissemination through social media will largely help in bridging knowledge gaps. Rural economy, agricultural extensions, health, infrastructure, education and other sectors have found these new media.

Innovating managerial solutions to maximize farmers' welfare – rather than relying solely on modern farming to raise productivity and production is the need of the day. As usual the pressures emanating from natural resource constraints, continuously happening fragmentation of land, unpredictable climatic changes, volatile input costs and post-harvest losses pose an enormous challenges to sustain the agriculture growth (Ganguli & Sinha, 2017). Emphasis on skill development in educational contents from the schooling level to increase not only the employability, but to include entrepreneurial among youth to aspire for self-enterprise formation and become a employment giver than a employment seeker is a new approach in imparting not only knowledge, but also market oriented skills through education, especially for the young women farmers. A scheme for promotion of innovation, rural industry and entrepreneurship (ASPIRE) was launched in 2015 to set up a network of technology centres, incubation centres to accelerate entrepreneurship and to promote start-ups for innovation and entrepreneurship in rural and agriculture based industry.

Farmers' Survey

The authors interviewed two award winning women farmers in Calicut region of Kerala and another two below poverty line (BPL) farmers in the Shahpur area of Himachal Pradesh. One of the Calicut area farmers namely REIIG is stingless bee and rubber grower. She gained

knowledge by visiting Nepal as part of farmers club. According to her climate fluctuation is the greatest threat to agriculture. She is of the opinion that several government policies and schemes are in vogue which are difficult to chase and take benefit of it. Another farmer namely Beena Babu interviewed at Calicut grew coconut, spices, vegetable and tubers received Aspee award for the second best women SHG engaged in organic vegetable cultivation. She received useful hints from a bank manager about agriculture and its financial benefits. SHG Kudumbashree helped her in forming a small group to uplift farming mainly organic farming. She is of the view that access to worthwhile knowledge and training are instrumental in improving farm productivity and profitability. However there is no place in her area for meeting and training of woman farmers. She lauded the help of Kishan Vikas Kedras and is now diversifying and extending farming activities to turmeric and banana. According to her neighboring male farmers are jealous of her and don't want to see her progress.

Another farmer interviewed in the 39 mile area of the Shahpur namely Swarna Devi has a status of below poverty line. As reported by her she is working very hard in the field and home to take care of farming activities and cattle. She said her poverty is the greatest impediment in improving farm productivity and family income. They have only six kanals of land to cultivate. No one ever came to their village to transfer farming knowledge or impart training in better ways of farming. If trained in mushroom production, they can enhance their family income. In her opinion monkey menace is the greatest threat to agriculture in their area. Presently they get agriculture produce to meet their food requirements of their family and fodder for their cattle and sell only a few quintals of grains to meet the cost of agricultural inputs. Another women farmer namely Pinki Devi from the Manjgrah village of Shahpur area also belonged to the BPL category and their family owned only 10 kanals of land for cultivation. They are not selling any agricultural produce as it sufficient only to feed their family and cattle. She reported that no extension worker ever visited their village to impart training or transfer knowledge pertaining to latest agricultural techniques. She reported that better seeds are generally distributed to some influential farmers.

Conclusion

Increasing population is putting recurring pressure to increase Indian agriculture productivity. Knowledge intensive agriculture practices involving greater application of biotechnology, more effective irrigation management and soil preparation, rain water harvesting, cost cutting, eco-friendly methods of weed and pest control and integrated farming are being pursued to make agriculture viable and more productive. Agricultural technologies have reached to extensive sophistication level. Some of the sophisticated future is already here with the development of aerial robotics or drones specially developed for agriculture, in combination with satellite imaging to zap weeds, harvest fruits at the right time or to deliver fertilizer and pesticide at prescribed intervals (Jishnu, 2017). Now farmers from Punjab are ready to use laser-guided tractors that plough fields with precision and digital apps for applying inputs and water to improve efficiency. Should, India adopt state of the art agricultural technologies or improve the traditional agriculture practices being pursued by a large number of small farmers? A country like India requires doing both at the same time. There is no dearth of agricultural innovations and ideas but their large-scale application in fields to improve agricultural productivity and economic lot of farmers is not happening. The country has an ambitious goal to double farmers' income by 2022. To achieve it massive efforts will be required to transfer need based situation and place specific customized knowledge in every field and training of farmers for pursuing more productive and profitable

agricultural practices are also necessary. Greater participation of women in agricultural practices in agricultural with enhanced autonomy and more resources also lead to better productivity and increase in farmers' incomes. Case analysis of several innovative models of farming by women reflects the presence of several best practices and role models across states of India. But country needs much more initiatives of such kind to meet the sustainable goals of food security and poverty alleviation. Not only educated women farmers have made a mark in agriculture but illiterate women farmers when trained and provided adequate knowledge and support have also made a difference in agriculture income. A large number of government initiatives, NGO's interventions and agriculture based corporate have come forward to help women farmers. Their efforts required to be integrated and consolidated for realizing greater impact. There is a huge potential to export medicinal plant based products and spices from India. Women farmers may be specially trained to grow medicinal herbs and spices and undertake organic farming. Corporates like Patanjali corporate of Swami Ram Dev should come forward to impart training and transfer knowledge to depressed and poor women farmers. It is not a matter of charity; it is a way out to show the way to such women farmers to do better and participate in all inclusive agricultural growth endeavors to enhance our national agricultural productivity.

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