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Dimensions of Livelihood in Rural India

CHIEF EDITOR

DR GOVIND SINGH

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Dimensions of Livelihood in Rural India

CHAPTER - 01

Sustainable Agricultural Development and Rural Livelihood in India

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1.1 Introduction

Livelihood is an important issue in Indian communities. To those who are engaged in planning, development, eradication of poverty, child development, women empowerment, and farmers & farm families development. A number of core challenges are identified, centered on the need to inject a more thorough-going political analysis into the centre of livelihoods perspectives. Agriculture, with its allied sectors, is unquestionably the largest livelihood provider in India, because of vast rural areas in India. It also contributes a significant figure to the Gross Domestic Product (GDP). Sustainable agriculture, in terms of food security, rural employment, and environmentally sustainable technologies such as soil conservation, sustainable natural resource management and biodiversity protection, are essential for holistic rural development. Indian agriculture and allied activities have witnessed a green revolution, a white revolution, a yellow revolution and a blue revolution.

Agriculture is one of the primary sources of livelihoods of the tribals, the effort is being taken by the organization to improve the agricultural practices resulting in an increase in productivity of crops and thereby ensuring year-round food security and enhanced income. Improved practices such as line sowing, System of Rice Intensification, use of organic manures and pest management practices, improved variety of seeds, mixed cropping, crop rotation, crop diversification, community farming, kitchen gardening, etc. are being promoted. Convergence with mainstream agencies and schemes are being done for better quality inputs, farm implements, extension services, etc. For the developing countries like India, where a majority of families, in both the farm and non-farm sectors, derive their livelihoods from agriculture, sustainability of agriculture cannot be discussed or even defined in isolation of the issue of livelihoods. Livelihood is defined as adequate stock and flow of food and cash with an individual or a family to meet its basic needs.

Livelihood security then means secured ownership of, or access to, resources and income-earning activities, including reserves and assets to offset risks, ease shocks and meet

contingencies. There are four principal ways of acquiring livelihoods by the rural households. First is the production-based livelihood. A large proportion of the small and marginal farmers gain livelihoods through production on small pieces of land. For these households, availability or access to inputs and improved methods of production are quite critical for their livelihoods. Second is the labour-based livelihood. Most of the small landholders and landless rural households derive livelihoods by selling their labour. For their livelihoods, demand for labour, wage rates and prices of food are the critical factors. Third is the exchange or market based livelihood. Those rural households which produce surplus food and non-food agricultural products or non-farm goods earn their livelihoods by selling these surpluses in the market. The marketing system for these products and relative prices of what they sell and what they buy, affect their livelihoods. The fourth set of livelihoods is transfer-based entitlements. The households without any income-earning asset or able-bodied person to work depend for their livelihoods on transfers from the government or other social organizations. Government's social security and food assistance programmes

1.2 COVID-19 Pandemic and Livelihood Approach

Recent data show that the magnitude and dimensions of poverty in India and thus the issues encompassing livelihoods of the poor. According to the recently published first National Multidimensional Poverty Index (MPI) released by the NITI Aayog that is based on the National Family Health Survey (NFHS) for 2015-16, using three dimensions viz. education, health, and standard of living, a quarter of India's population was still poor in that year. MPI for 2021, launched by UNDP and Oxford Poverty and Human Development Initiative, University of Oxford, prepared on basis of 10 indicators such as nutrition, years of schooling, access to cooking fuel, sanitation, drinking water, electricity, etc., shows that 27.9% of India's population are multidimensionality poor.

Given devastating impact of the COVID-19 pandemic in its many forms and slowdown on all economic fronts over the last two years, the livelihoods of cross sections of the population in the country have been hard hit. While India had made remarkable strides to end poverty in recent years till 2019, the unprecedented COVID-19 pandemic slowed decades of progress to a large extent, halting the pace in improving livelihoods - be it farm, non-farm or off-farm segments and thereby exacerbating the poverty situation.

A class of 'new poor' is an added challenge to India due to job loss, reverse migration, slowdown in industry and services sectors. However, in spite of the prevailing pandemic situation, there are some good signs too. As per the Brookings report, India is no longer the country with the world's most poor. As per the real-time data from the World Poverty Clock,

6% or 86.8 million of the Indian population are living in extreme poverty, but 30 Indians are also escaping extreme poverty every minute.

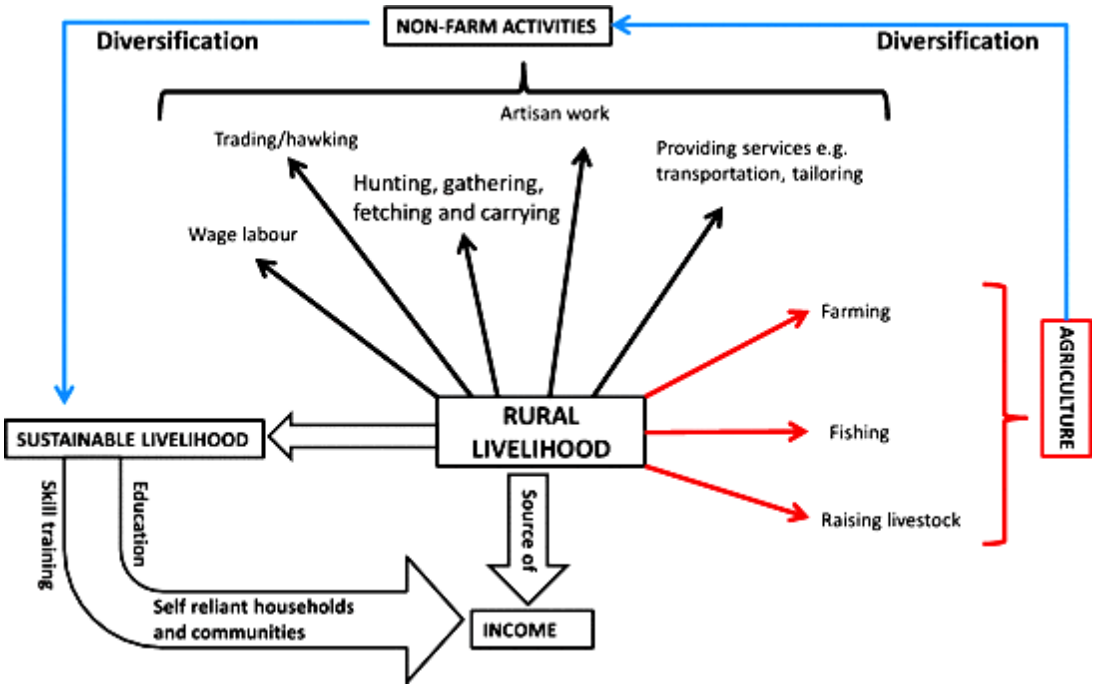

Figure 1.1 : Livelihood Approach for Sustainable Development

In order to protect livelihoods, the Government has initiated several measures, including ensuring food security, cash transfers to farmers and poor households, and economic stimulus towards the economic recovery and strengthening the health infrastructure. The major challenge remains to accelerate the strategies and utilise the available resources towards the faster revival and reconstruction of economic activities along with a fight against the COVID-19 pandemic.

1.2.1 Current Levels of Poverty and Deprivation

While discussing sustainability of agriculture, the fact that poverty continues to be a major problem in many parts of the world cannot be ignored. If poverty line is defined as one dollar per day, nearly 1.2 billion people live below this income. Poverty is more pronounced in the rural areas. Seventy-five per cent of the total poor live and work in the rural areas. Asia accounts for about two-thirds of the total world poor, with South Asia accounting for 43%. A significant proportion of the rural poor lives in less favoured areas that are challenged by difficult agro-climatic conditions such as poor soils, low and unstable rainfall, steep slopes, short growing season and inadequate infrastructure and support services. Most of the poor

people are also food-insecure. As regards India, though there is a debate on the incidence of poverty, it is absolutely clear that (a) the poverty ratio has been declining over time; (b) the absolute number of poor continues to be high; and (c) malnutrition is very high among not only children but adults also. The number of poor, which hovered around 321 million during the 1970s and 1980s, declined to 260 million during 1999-00.

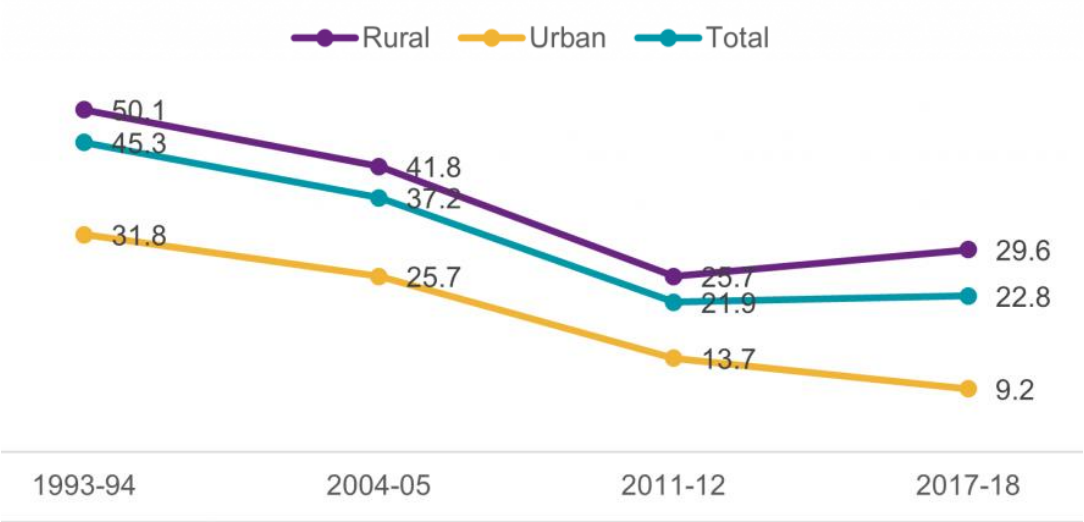

Figure 1.2 : Rural and urban participation in agriculture

The poverty ratio, defined as the number of poor as a percentage of total population, however, declined continuously from 54.9% in 1973-74 to 44.5% in 1983, 36.0% in 1993-94 and further to 26.1% in 1999-00. Spatial distribution of poor in India shows that 48.1% of them live in three states, viz. Bihar, Uttar Pradesh and Madhya Pradesh. Maharashtra, Orissa and West Bengal account for 23.5% of India's poor. These six states together account for 71.6% of India's poor. The studies show that the poverty ratio is higher among households in

Incidence of Poverty		As per NSS CES data		As per PLFS data
		2004-05	2011-12	2019-20
Poverty Head Count Ratio (%)	Rural	41.8	25.7	30.5
	Urban	25.7	13.7	15.5
	Total	**37.2**	**21.9**	**25.9**
Number of poor (Million)	Rural	325.8	216.7	270
	Urban	81.4	53.1	71
	Total	**407.2**	**269.8**	**348**

Figure 1.3 : Current Levels of Poverty (%) in rural and urban area

the low-rainfall and unirrigated areas than others. Across rural occupational categories, the incidence of poverty is the highest among agricultural labour households, followed by other labour households, self-employed in non-agricultural activities and self-employed in farming. Within each of these occupational groups, incidence of poverty is higher among owners of tiny landholdings as compared to landless households, which raises a fundamental question whether ownership of tiny holdings is a boon or bane.

1.2.2 Basic Issues in Sustainability

As already mentioned, sustainable development basically implies attainment of the objectives of inter-generational equity. Given the extent of poverty and food insecurity, it can be argued that there is some tradeoff between alleviating poverty from the present generation and caring for the future generations. The main issue is, therefore, setting up of priorities between the welfare of presently deprived families and sustainability of resource-use. The problem of priority setting gets further compounded due to the existence of very large (and further growing) inter-personal, interregional and inter-country inequalities in the

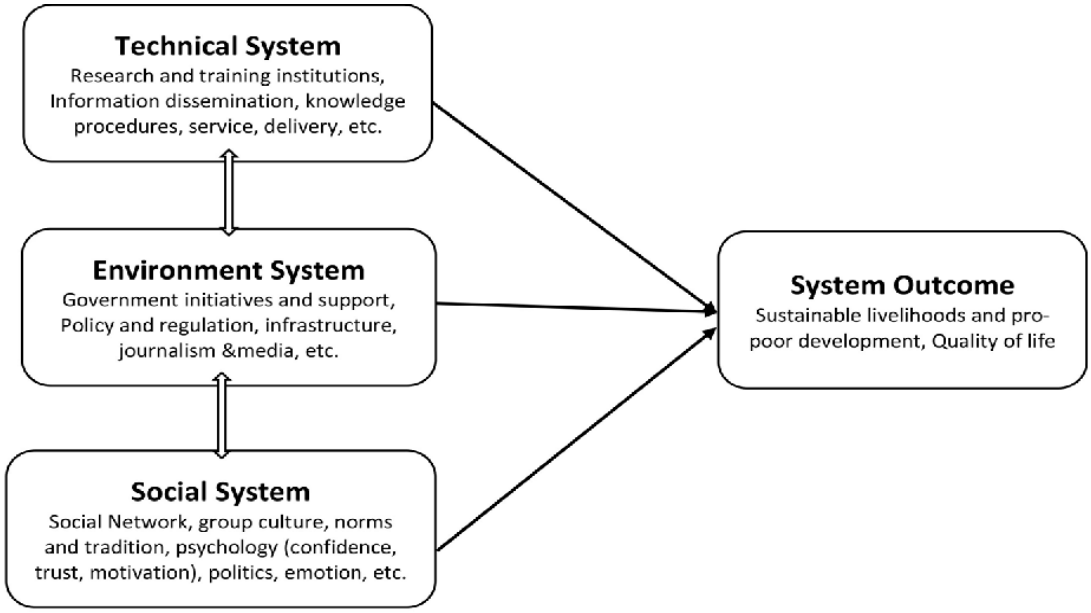

Figure 1.3 : Factors of sustainable livelihood

livelihoods of the present generation. There is also a source of conflict between developing and developed countries in protecting the global environment. The damage to the environment in low-income countries is very low compared to that in the developed countries. It has been quoted that in 1996, per capita carbon-dioxide emission in low-income countries was 1.1 metric tonnes as against 12.3 metric tonnes in high-income countries.

In the industrialized countries, these are reported to have further gone up during the last ten years, despite agreements on curbs meant to fight global warming. Given this, setting of similar standards of reducing emissions is being contested on the world forum. Even if it is recognized that environmental degradation is public bad, the shadow price for valuation of degradation cannot be uniform across countries. It is being argued that the shadow prices ought to be a sovereign decision of a country and should not be dictated by those who do more damage to the environment. The incidence of poverty is very high among tribal societies. Out of all the societies, tribals live closest to the nature and environment.

1.2.3 Issues in Sustainability of Agriculture

The non-economic dimensions of livelihood are particularly important when observing what we have all seen in the past year, the devastating impact that the COVID-19 pandemic in its many forms (waves) has had on the citizens, particularly the poor and vulnerable. Food and Agriculture Organization (FAO) has defined sustainable agriculture as the management and conservation of resource base and the orientation of technological and institutional changes in such a manner that ensures attainment and continued satisfaction of human needs of present and future generations. It follows that sustainable agriculture is that path of agricultural development, which is environmentally non-degrading, technologically appropriate, economically viable and socially acceptable. It must be recognized that agriculture by definition is the most aggressively managed ecosystem, which is closely linked to the world's food system. If the alternative to agricultural sustainability is the collapse of the world's food system, there is definitely no compromise. However, in predominantly rural economies like India, growth of agriculture is critical to the achievements of goals of poverty reduction and household food-security. This requires resolution of the issue of trade-off between sustainable agriculture and a growing agriculture.

1.3 Paradigm Shift in Agricultural Research and Technology

India has been successful in building a massive ecosystem of science, technology and innovation since independence in 1947. Globally, Agricultural technology continuum has been the main driver of agricultural growth, development, and transformation of national socio-economic and agro-ecological milieus, and evolving dynamically to meet the fast changing development goals. Today, in the midst of the unprecedented COVID-19 pandemic, the world is challenged to meet the new and emerging health and nutrition demands along with the United Nations' Sustainable Development Goals - Agenda 2030. Agricultural technologies have continuously been transforming the agriculture-food-systems in the past,

the paradigm shifts in agricultural research are needed for making these more efficient, knowledge-based, inclusive, and sustainable, in providing solutions to the new and emerging challenges, and capturing uncommon opportunities. Smallholder and marginal farmers, accounting for nearly 86.25% of Indian farmers, 47.38% of the cultivated land and over 50 percent of the total agricultural production, are vital not only for India's agrarian economy (10th Agriculture Census 2015-16), but also for achieving alleviation of hunger and poverty. Over 50% of the smallholders, referred to as sub-marginal farmers, possess less than 0.5 ha land. Despite their higher per unit productivity, the extremely small and fragmented holdings are economically non-viable, swelling the ranks of hungry and poor.

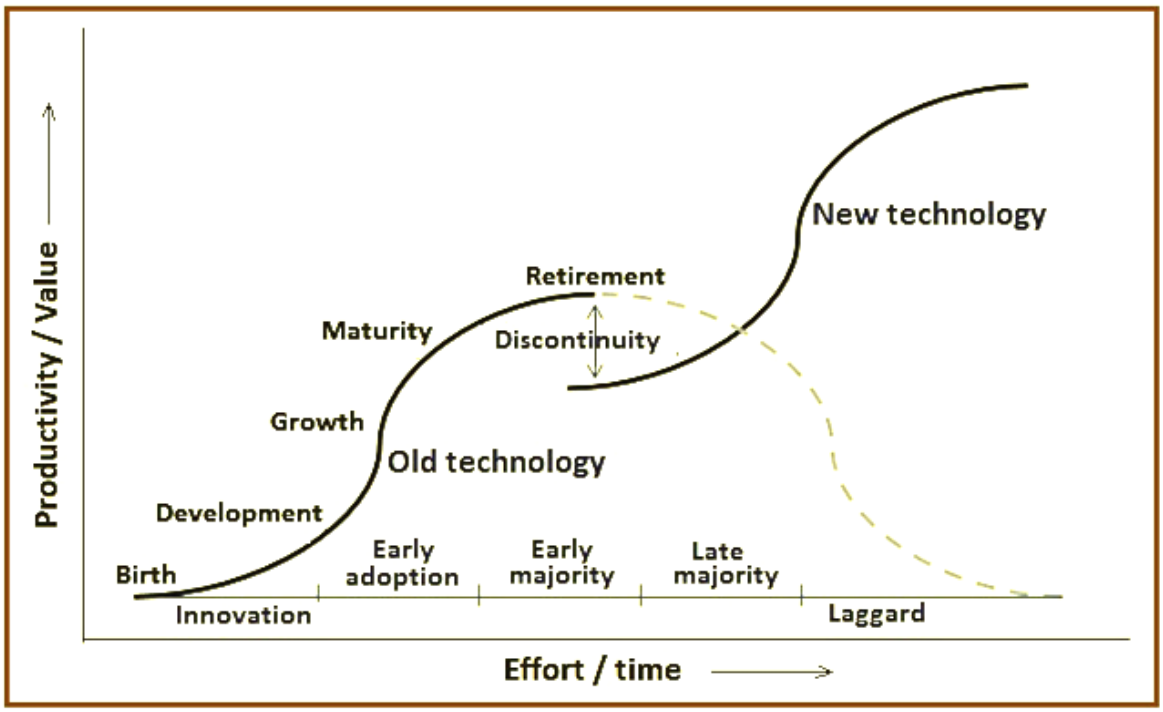

Figure 1.4 : Paradigm shift and diffusion of new technology

The bio-diverse, predominantly crop-livestock mixed-farming in India is the key to ensure resilience to climate change and sustainability of smallholder farming agro-ecologies. In the post-Green Revolution period, agricultural research in India gradually moved from crop-based to farming system - based agriculture integrating horticulture, livestock, poultry and fisheries as essential components to achieve sustainable food and nutrition security and to maximize farm income. For the economic and nutrition security of a largely vegetarian population, dairy animals are of prime importance; and to improve their productivity and climate resilience, a two-pronged approach will be required–strengthening the availability of

superior germplasm and enhancing fertility through biotechnological augmentation of reproduction. The efforts to make this happen comprise inter-disciplinary collaborations in developing innovative production and processing technologies, including nutraceuticals and fortified nutri-foods; cold chains involving refrigerated van using conventional and non-conventional energy sources, and necessary policy support to agro-industries and all will play critical roles.

1.4 Commercial Agriculture - From Green Revolution to Gene Revolution

Indian agriculture-food system economy is greatly prone to climate change consequences. India is projected to be one of the most negatively impacted countries by the climate change. A paradigm shift to imbibe interdisciplinary, participatory, and international collaborative approach can address the multiple challenges caused by climate change while sustaining the desired economic growth. Recalling the country's pledge of Doubling Farmers' Income by 2022/23, a USD 5 Trillion Economy by 2024/25, and Alleviating Wide Inequalities (farmers' average income being one-fourth of that of non-farmers), farming must be treated as an enterprise. Good post-production technologies, robust entrepreneurship initiatives, and establishment of agro-industries in rural areas should foster economic and employment

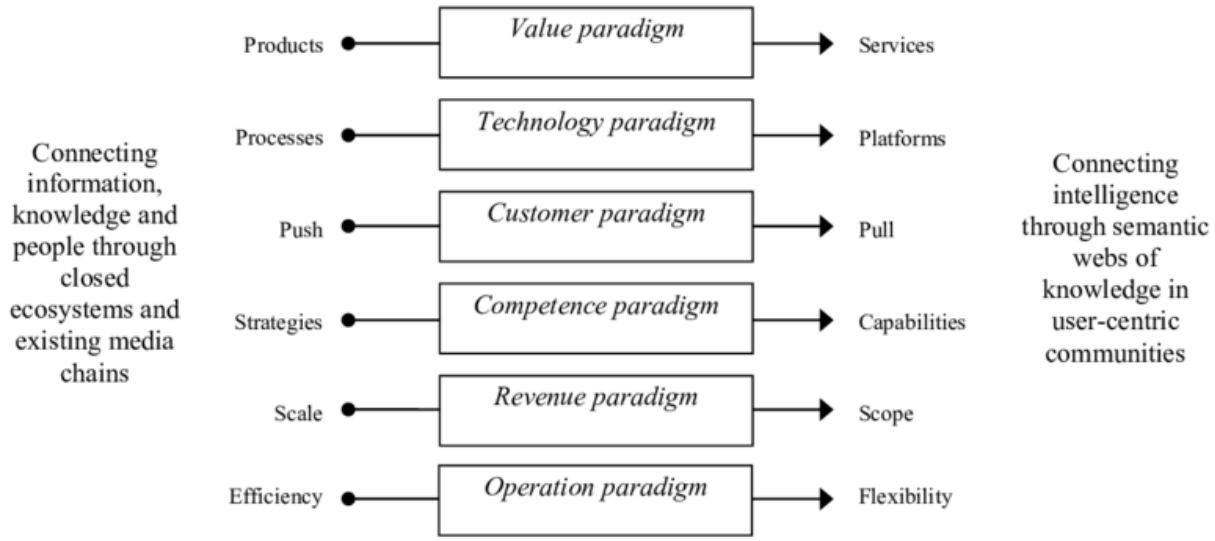

Figure 1.5 : Paradigm shifts and related factors

security and attract youth in agriculture-food systems, thus harvesting India's huge demographic dividend and achieving agrarian transformation. The classical plant breeding uses deliberate interbreeding (crossing) of closely or distantly related species to produce new crops and varieties with desirable properties. Plants are crossed to introduce

traits/genes from a particular variety into a new genetic background. In this, highly heritable oligo genes and exploitation of additive and dominance gene effects and interactions, led to the development of short stature, input-responsive, high yielding varieties (HYVs), often resistant to common diseases and pests, which ushered in the Green Revolution in the country especially in wheat, rice, maize, pearl millet and sorghum.

Genomics and gene editing must be adopted as preferred technologies for precision breeding. However, to do so, a science-based policy and well defined guidelines need to be placed on priority. In the new era of genomics, phenomics, proteomics and other omics – molecular breeding, the availability of high quality reference genomes of crop plants accelerated the discovery of genes, quantitative trait locus and DNA markers linked to the traits of agronomic importance. As horticulture attains high importance, genomics of coconut, mango, banana, aonla, pointed gourd, tuber crops etc. need greater attention. In livestock, genome editing has high prospect of enhanced prolificacy and reproductive performance, improved health, increased feed utilization and growth rate, carcass composition, improved milk production and or composition, and increased disease resistance. Using Big Data Analytics, we can create decision support systems at various levels, including weather forecasting and efficient management of water, pest, and nutrient. Linked with satellite imagery, this can also help in future predictions of produce and price. Comprehensive and reliable data resources are conducive to augment AI that can bring a paradigm shift by developing smart farming practices using IoT (internet of things) to address the uncertain issues with utmost accuracy that will enable farmers to do more with less, and also provide new business opportunities to youth as well. AI can also be used for high throughput plant phenotyping, monitoring of natural calamities and crop residue burning.

1.5 Attracting Youth and Empowering Women in Agriculture

Women are central to agriculture and make a strong contribution to food security and nutrition at both the household and community levels. In many developing countries, they make up almost half of the agricultural labor force, but their production is limited by barriers to finance, inputs, and extension services, as well as land ownership and rights. Women in agriculture play a vital role in wide range of activities, thereby contributing to sustainable agricultural development. To achieve inclusive agricultural growth, empowering women by having comprehensive understanding about work participation, gender issues, drudgery and health and nutritional status is necessary. Further, these issues are to be addressed through gender-friendly technology assessment, refinement and extension methodologies. Globally,

there is an increasing concern about the generational gap in agriculture, the farmers are getting old, as the youth is not inclined to practice agriculture.

Nations with motivated youth engaged in diverse, secondary and specialty agriculture, supported by enabling policies, have progressed well. India has only 5% of the rural youth engaged in agriculture though over 60% of the rural people derive their livelihood from faming and allied activities. The principle of 'Leaving no one behind' though requires closing the gender gap, the female farmers, representing more than a quarter of the world's population, remain invisible in policy and decision making at every level of agricultural development. They neither have equal rights nor access to assets, information, inputs and services. In addition, women face excessive work burden, much of which remains unrecognized and unpaid. The World Bank and FAO recognized that had women enjoyed same access to productive resources as men, they could easily boost production by 20-30% raising the overall agricultural output in developing countries by about 4%.

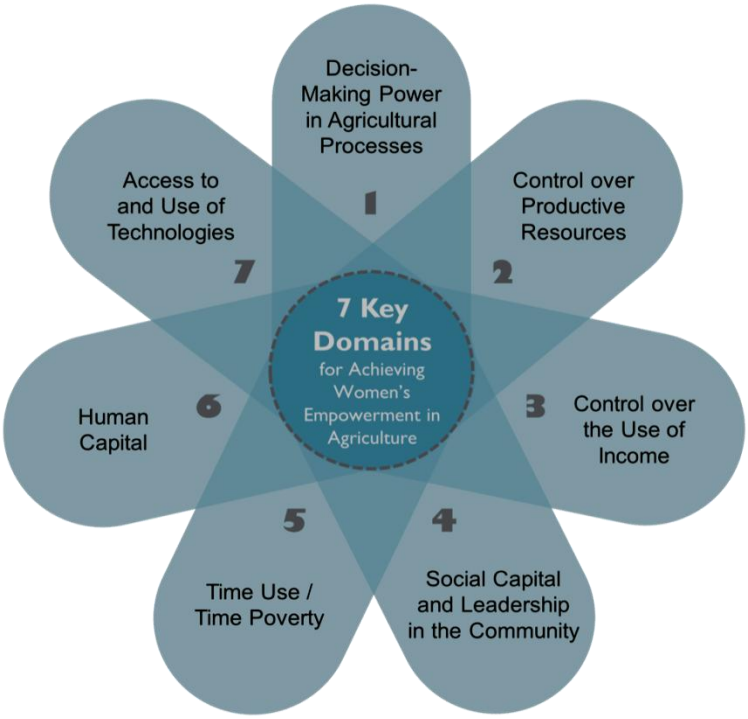

Figure 1.6 : Key domains related to poverty elevation

1.5.1 Women in Agriculture - Bridging the Gap

Agriculture, one of the largest contributors to India's Gross Domestic Product (GDP) and a driving force for country's economic development, relies heavily on women employing the

largest number of women in India. Women's continued role in agriculture is well marked, well realised, however, it is often underestimated. Close to 75% of the full-time workers on Indian farms are women. In rural India, the percentage of women who depend on agriculture for their livelihood is as high as 84%. India's livestock sector, which is the world's largest livestock production systems--over 70% livestock work is done by women. Women's participation rate in the agricultural sectors is about 47% in tea plantations; around 47% in cotton cultivation; 45% growing oil seeds, and 39% in vegetable production. Despite their large presence and their contribution, women farmers, often, are not equipped with what they need to succeed in farming. Studies have shown that women have less access to inputs (seeds, fertiliser, labour and finance), critical services (training, insurance) and organised markets when compared to their male counterparts.

This inequality comes with a social and economic cost. Research has consistently shown that inequity in access to resources impacts both the economic well-being of women farmers as

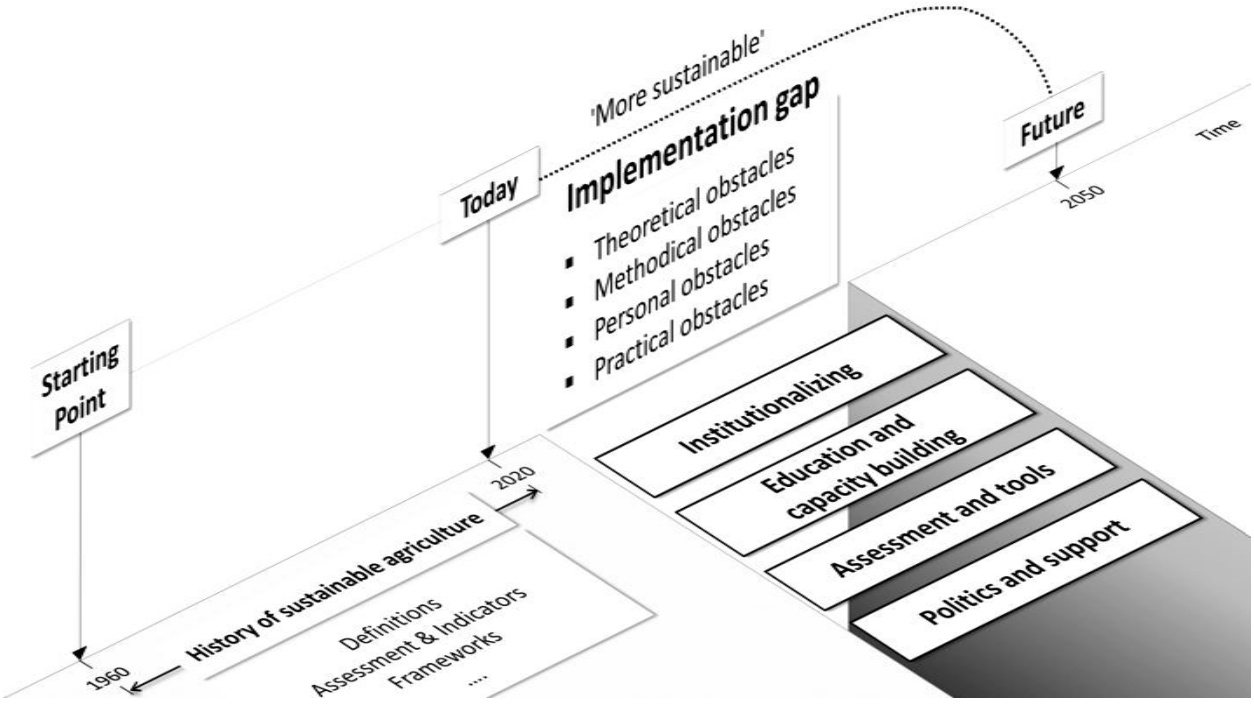

Figure 1.7 : Sustainable approach for poverty elevation

well as overall agricultural output of the country. The Food and Agriculture Organisation of the United Nations estimates that if women were to have the same access to productive resources as men, they would increase the yields on their farms by 20-30% and this would end up adding at least 2.5–4% to the total agricultural output in developing countries. Similar

inequalities are evident in price realization where in view of unequal access to formal markets, women often realise less price for their produce than their men counterparts.

One of the key areas for addressing inequality is land ownership. Land is a fundamental resource for farming. With less than 8% of women farmers owning land, they often end up farming without being categorized as farm owners or landowners. Access to land and access to good soil (women also often own land that have inferior soil than their men counterparts), therefore, would be a fundamental requirement towards addressing the inequalities. Limited ownership of land is not a problem associated just with India, it is in most agriculture dependent countries, where, unlike India, women often do not even qualify to own land.

The second factor is markets. If land is the first step in farming, markets are the ultimate reason for farming. The consistent disparity in price realization has been well documented. One of the key reasons behind this is the disparity in access to catalytic technologies. Take the example of digital technologies that are increasingly becoming essential to connect farmers to markets. Mobile phones, for example, are becoming a very important tool in farming- to buy, sell, report, debate, transfer money, claim insurance. However, across low- and middle-income countries, women are 10% less likely to own a mobile phone than men, and 313 million fewer women than men use mobile internet. As such, social inequalities are often manifested into digital inequalities.

1.5.2 Technical Approach

Recent years have seen the agriculture industry making steady progress in areas such as crop diversification and tech adoption. The emergence of Agritech companies is furthering the cause of making agriculture profitable and sustainable for the farmers. Since technology is one of the critical aspects of service delivery, the Agritech companies require an active on the ground workforce to sensitise the farmers on these developments and migrate them to such platforms. This requirement helps Agri platforms drive the gender-diversity agenda. They can bring more rural women onto gig-economy-based flexible work models, extending them with employment opportunities like never before. By being diverse and inclusive, these companies allow for a better outcome which takes into account a sense of nurturing, care, empathy and inclusiveness.

Women are always open to what's better for their families and communities, therefore more open to learning new ideas and adopting new progressive practices, which is why women centric micro-financing models, cooperative societies and self-help groups are a success. Because of these attributes, recent years are witnessing a spike in creating a rural women

workforce who are hired, trained, and upskilled by the agtech companies to educate and empower the farmers towards tech adoption. Such training models impart rural women soft skills such as interacting with potential partners and market links, driving sales, teaching them about money management, utilising technological tools, securing loans, investing their

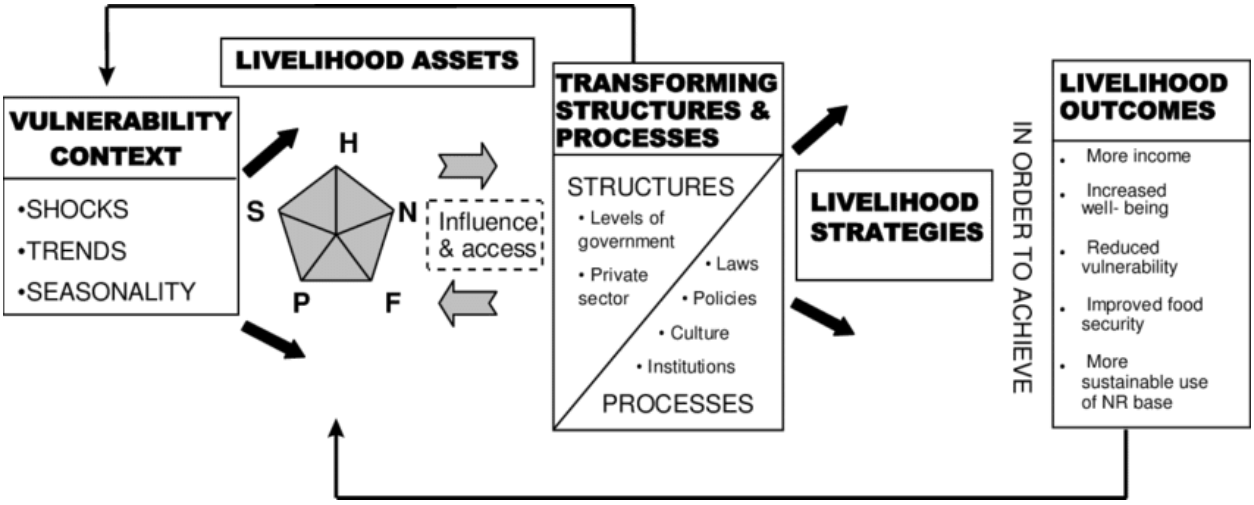

Figure 1.8 : Integrated approach for livelihood strategies

money, and more. By enabling these flexible work models, rural women in agriculture can ensure their financial, social, and emotional independence and prioritise their health and safety to thrive in the ecosystem. The additional income they generate gives them a voice at the family decision-making table, and they earn the respect of their peers and inspire more women to join the workforce. Bridging the gender gap in agriculture will benefit women in agriculture, the industry, and the society. As per a report by FAO, empowering women working in the agriculture sector with equal access to opportunities and resources may even boost farm output and yield by 20-30%. In developing countries, resourceful women in agriculture can increase total agricultural production by 2.5-4%, enhancing food security. Continued support and guidance for women in the farming sector will enable the sustained growth and development of the entire ecosystem.

A sustainable livelihoods approach is an integrated application for poverty eradication through the incorporation of the economic, environmental and social equity principles in access to and consumption of resources. Accordingly, sustainable livelihoods efforts in India comprise a vast set of interventions, cutting across diverse communities, objectives and impact strategies. The focus of the sector has long been, and continues to be, on agricultural and related sectors. However, there is also an increasing emphasis on the importance of skill development, entrepreneurship and innovation. Over the years, many sustainable

livelihoods frameworks have been created to effectively tackle poverty eradication and promote economic, environmental and social equity. For example, CARE (Cooperative for Assistance and Relief Everywhere) has adapted the Chambers and Conway definition to develop a household livelihood security framework that embodies three fundamental attributes: the possession of human capabilities (such as education, skills, health, psychological orientation); access to tangible and intangible assets; and the existence of economic activities. The United Nations Development Programme or the UNDP employs an asset-based approach, which concentrates on community access to and sustainable use of those assets. UNDP places emphasis on the need to understand coping and adaptive strategies to shock and stress, as this is integral for substantive poverty reduction interventions, and also champions technological advances to expedite and deepen impact. DFID's sustainable livelihood approach supports scrutinizing the factors which contribute toward poverty and attempts to decipher the relationship between these factors and the institutions, policies and social/community asset

1.6 Sustainable Livelihoods Work in India

Sustainable livelihoods efforts in India comprise a vast set of interventions, cutting across diverse communities, objectives and impact strategies. The focus of India's sustainable livelihoods sector has long been, and continues to a large extent, to be on agricultural and related sectors. This is reflected in the government's budget and programming. In recent years, the union budget has prioritized agriculture over other sectors and has highlighted a number of priority areas such as doubling of farmer income, irrigation, sustainable management of groundwater and promotion of organic farming. The Indian government's flagship livelihoods program, Aajeevika – National Rural Livelihoods Mission (NRLM), which has been renamed Deendayal Antyodaya Yojana – NRLM, too is focused around agriculture and allied sectors, including sustainable agriculture and non-timber forest produce. The Mission aims to create efficient and effective institutional platforms of the rural poor, focusing on self-managed Self-Help Groups (SHGs) and federated institutions. There are multiple components to the program, including livelihoods promotion, financial inclusion, institution and capacity building, and social inclusion and development. Crucially, the inclusion of skill development, along with self-employment and entrepreneurship as focus areas in the NRLM reflects an emerging trend. In the livelihoods sector in India, there is increasing discussion around skill development, entrepreneurship and innovation. According to the SOIL (State of India's livelihoods) report of 2017, unemployment is steadily rising, and labor force participation rates are declining. To meet demand, 103 million new jobs and skill

training for 127 million are required by 2022. In such a scenario, and to keep up with these numbers, skill development and entrepreneurship building take center stage.

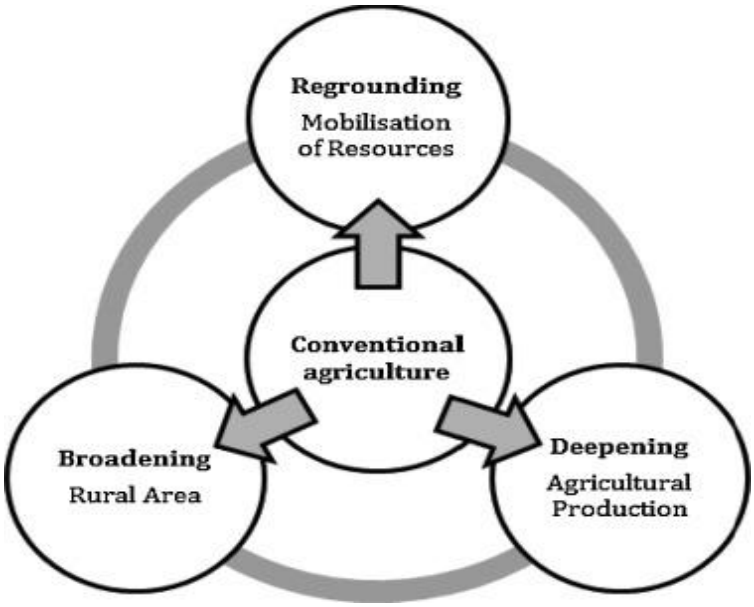

Figure 1.9 : Factors of conventional agriculture

In order to fill the rising skilling requirement, the Indian government launched the National Skill Development Mission in July 2015, with a mission to train 400 million people by 2022. It intends to accomplish this through a combination of training courses through different ministries, state governments, and training partners. Achieving the target however, is most definitely an uphill task. The skill development sector in India presents a dual challenge: there is both a lack of specialized, skilled labor, as well as high levels of unemployment among educated segments of the workforce. This situation is the result of a combination of factors, including inadequate training infrastructure, outdated curricula and a fractured vocational training industry. The lack of incorporation of job-based skill requirements into the formal education system further contribute to low levels of employment. A concerted institutional effort is thus required from both private and public providers of skill development services to ensure sustainable employment for the youth.

In the case of entrepreneurship, with the launch of the Atal Innovation Mission, the government has taken a major step towards the promotion of innovation. According to a NITI Aayog expert committee report, encouragement of entrepreneurship as a career is critical to meeting the growing demand for jobs. However, a majority of entrepreneurs in India today are self-employed and have individual driven micro-enterprises. In contrast, job

creation in markets such as China and Bangladesh, has been driven by enterprises hiring one or more people. It is thus crucial to bring about a focus on 'mass entrepreneurs', who hire or increase the incomes of 5-20 workers, solve local challenges and/or use local inputs.

Conclusion

Livelihoods are an important part of human existence. In most rural areas of the world, approximately 90 % of the population is involved in farming as a way of earning a living. Small-scale farming, fishing, raising livestock and non-farm activities are some of the common livelihoods that these populations survive on. Economic growth creates opportunities for a wider choice of livelihoods. Sustainable livelihoods are needed for economic growth and development of rural populations. There is need for human, social, economic, financial, physical and natural capital for livelihoods to be sustainable. Rural livelihood poses a great challenge as these populations are often in a state of poverty where they lack the basic necessities for survival. A rural household with diverse sources of income earning activities has better chances of survival financially than a household which has only one source. Delivery of quality education and training in a variety of skills in rural areas is therefore needed to attain sustainable rural livelihoods. In order for a rural population to strive there is need for livelihoods that would sustain and support their households and communities. Diversification of livelihoods increases chances of economic growth and survival of a household. Livelihoods have been affected by shocks such as natural disasters and disease outbreaks which have led to partial and/or complete loss of livelihoods. Natural disasters contribute to emergence and re-emergence of infectious diseases. These diseases play a role in livelihood sustainability as well as diversification.

The sustainable livelihoods sector in India is an amalgamation of varied interventions, cutting across diverse communities, geographies and occupations. Given the dynamic and constantly evolving nature of the domain, a demand-side view of the funding landscape of sustainable livelihoods provides insight into the prevalent funding patterns, and helps identify the existing funding and resource gaps in the sector. At an organization level, it was found that meaningful engagement of funders with the organizations they support can lend to more impactful change. In addition, non-programmatic support from a donor works to further deepen this impact by increasing an organization's effectiveness and efficiency. At a sectoral level, the encouragement and enablement of collaborations between different implementers can lead to a more efficient utilization of limited resources. Moreover, donors must work to increase their geographic outreach to reach marginalized and often neglected populations. In terms of thematic areas, supporting market linkages and funding

entrepreneurship and innovation emerged as key areas for funder intervention in the sustainable livelihoods domain

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Dimensions of Livelihood in Rural India

CHAPTER - 02

Organic Farming: A Step towards Sustainable Living

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2.1 Introduction

Concept of organic farming is not new, it's an ancient practice of producing food. After independence during the nineteenth century we started growing high yielding varieties with intensive use of synthetic chemicals to fulfil the food demand for growing population which is also known as the green revolution. Agricultural production achieved a new height and now its impacts are visible as decreased soil fertility, reduced groundwater levels, increased pollution, contaminated soil and water bodies affecting everyone, thus compromising human health. Conventional farming needs more inputs of energy and chemical fertilizers.

Modern agricultural practices add huge quantities of chemical fertilizers to increase production. Further spraying synthetic insecticides and pesticides to protect their crops from insects and pests negatively affects human health. Though agricultural production has reached a new height however, excess chemicals get into soil and water bodies and enter the food chain affecting the whole ecosystem. Harmful chemicals remain in our food products even if in minute quantities have adverse effects on our health and make us sick.

Good health is one of the major concerns for all of us and organic farming is an alternative to grow healthy and safe food without harming the ecosystem. After experiencing the long term impact of conventional farming, acceptability for organic farming is now increasing rapidly. Organic farming is a type of agriculture that avoids the use of synthetic fertilizers, pesticides and other chemical inputs. It relies on crop residue, bio-fertilizer,crop-rotation, mixed cropping.

Biodegradable insecticides and pesticides derived from natural sources are used that do not have adverse effects on human health and ecosystem. This method not only reduces the cost of food production but also provides healthy and safe food, further it helps in maintaining the soil fertility and health of the ecosystem. Organic foods are nutrient rich, contain higher levels of plant secondary metabolites that acts as antioxidants and protects us from

oxidative stress. Organically grown food products also reported to contain fewer amounts of pesticide residues and are good for health.

2.2 Need of Organic Farming

The Green revolution aimed to enhance the farm yield to feed the growing population. During this period more and more chemical fertilizers were added along with other chemicals used to control insects and pests. Excessive use of natural resources adversely affected the soil fertility and created an imbalance in the ecosystem. Sustainability of the farming system and health of the ecosystem both are matters of global concern. Intensive cultivation affected the physical properties of soil, along with soil microbes, made soil nutrient deficient and soil less fertile.

Figure 2.1 :*Is organic farming same as primitive farming in ancient times?*
(Source-Google free images)

Organic farming is an alternate way of farming based on the principle of a pollution free environment, quality food, and a healthy ecosystem supporting life. In order to sustain we have to maintain harmony with nature and maintain a balance. According to Saha et al., 2008 farms managed with organic material showed improvement in fertility and quality of soil. Organic manure and crop residue added to soil promoted the growth of soil micro-

organisms and enhanced the crop yield. Promoting organic farming is not to revert to traditional methods of food production but to combine it with modern techniques and scientific knowledge for long term benefits. Though a large area is still under the conventional farming practice, shifting from conventional to organic farming will not only promote ecological harmony but also help us to maintain environmental sustainability.

2.3 Different Practices in Organic Farming

2.3.1 Crop rotation : This practice is based on the fact that if we grow a particular crop again and again in the same field it will reduce the crop productivity and promote growth of pests and diseases. Different crops differ in their nutritional requirements, therefore when a non-legume crop grown after a legume crop (pulses) gets sufficient nitrogen in soil. Some soil bacteria such as *Rhizobium* naturally form symbiotic relationship with leguminous plants fix atmospheric nitrogen for plants. Legume crops are grown after non-leguminous crops (cereals) with the aim to restore soil fertility. Growing different crops in successive years ensures efficient use of nutrients and also checks growth of pests by breaking the disease cycle.

2.3.2 Mixed cropping : Different types of crop plants are grown simultaneously for proper utilization of the field and more than one variety of crops can be harvested at the same time. Mostly pulses are mixed with cereals such as pearl millets. Mixed cropping practice not only improves the crop yield but also minimizes pest infestation and risk of crop failure.

2.3.3 Soil nutrition: Farmyard manure, plant waste, decomposed organic residue is added to enrich soil. Microorganisms present in soil act on this organic matter and provide nutrients for plants to grow. Organic matter promotes biological activity in soil and enhances soil fertility.

2.3.4 Cover crops: Crops are generally grown as green manure and animal feed in rain fed regions to cover soil. These crops are not harvested and organic matter thus added improves soil texture. It slows down surface runoff, improves water percolation and also prevents soil erosion.

2.3.5 Mulching: Practice of covering soil surface with organic waste such as dried leaves and straw, hay, wood products and other plant and animal residue. Mulching protects soil during drought and delayed rainfall. Later on this organic matter gets mixed into soil and improves soil quality. Further, nutrient status and water holding capacity of soil also improves. It also prevents soil erosion and keeps check on growth of weeds. ICAR under

National Policy for Management of Crop residue also guides farmers to use crop residue as mulch instead of burning it.

2.3.6 Bio-fertilizers : They are microbial inoculants such as *Rhizobium, Actinorhiza*and *Azospirillum* and blue green algae added to soil. It's a natural and cost effective way to improve soil quality. They restore natural recycling of nutrients; promote microbial activities that involve nitrogen fixation, and phosphate solubilisation that ensures availability of phosphorus in soil. They play a significant role in maintaining the soil quality in organic farming practice.

2.3.7 Green Manure : They are fast growing living mulch that are used as manure. Crops such as *Sesbania sesban* (Jayanti), *Crotalaria juncea* L. (sun hemp) and *Cyamopsis tetragonoloba* (cluster beans) are grown in the field and mixed in soil while green. Green manure improves the physical structure of soil, adds organic matter and provides nutrients for crops.

2.3.8 Resistant crop varieties: These varieties selected for cultivation to avoid the use of insecticides and pesticides as protection measures. Further, biodegradable insecticides and pesticides derived from natural sources are used. Above mentioned processes support natural recycling of nutrients, enhance soil structure and moisture along with microbial activities and sustainability of soil life.

2.4. Types of Organic Farming

2.4.1 Pure organic farming: It totally relies on natural resources and strictly avoids use of any synthetic chemical as fertilizer and pesticides. Nutrient status is maintained only through natural manure and insect pests are also controlled with naturally derived eco-friendly products.

2.4.2 Integrated organic farming: This farming system combines the use of modern management tools and latest technologies with traditional knowledge and available local resources. This practice has a dynamic approach and is commonly used all over the world. Example- fish rearing and rice cultivation, poultry and dairy farming with organic farming is common practice.

2.5. Organic Farming in India

Conventional farming seems to be more profitable than organic farming because of its higher crop productivity. However, lower market rate and more investment in chemical fertilizers and insecticides can affect its profitability. Growing health awareness has created more

demand for organic products. Due to limited supply of certified organic products, they are more expensive than conventional products. Organic farming practices are not only cheaper but also ensure sustainable livelihood even to small farmers (Singh 2019). Farmers growing organic products can get premium price for their products as they have international demand among the health conscious people. Global acceptability for organically grown herbal products is increasing rapidly.

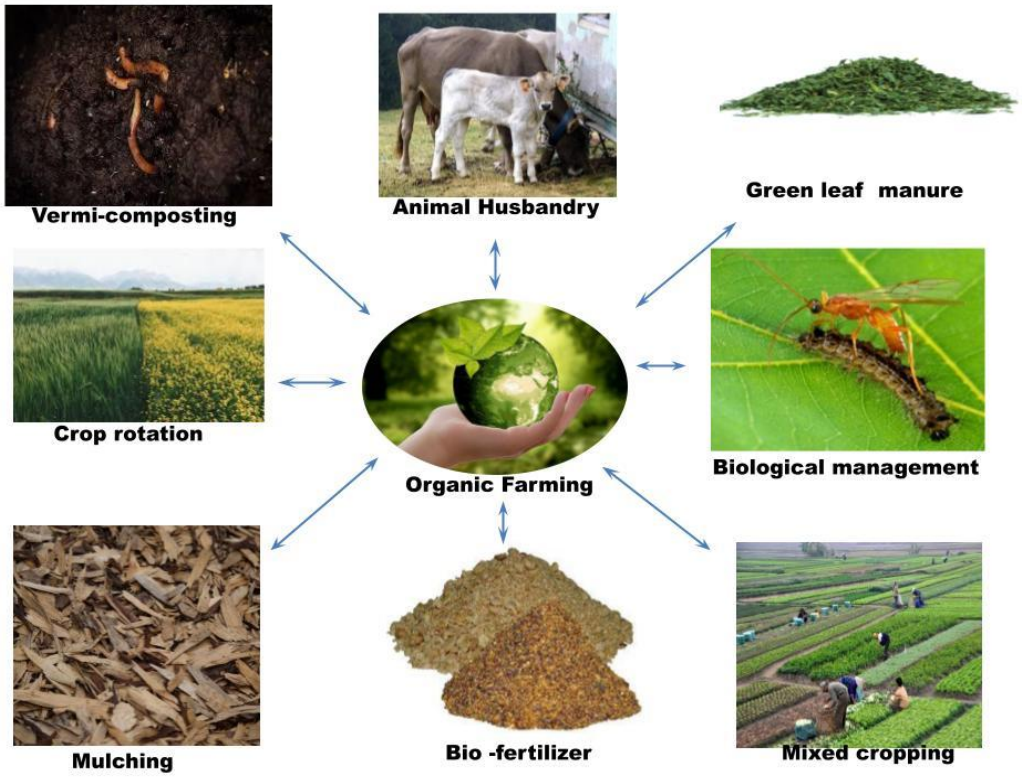

Figure 2.2 : *Practices in organic farming*

Moreover, organic products are getting higher value for example *Plantago ovata* husk from organic farms costs six times more than its conventional counterpart. Likewise, organically produced senna (*Cassia angustifolia*) leaves are sold at higher cost. Looking at the developing market for organic products India can look towards organic farming of medicinal and aromatic plants.

Medicinal plants are either used as a whole plant or its specific part like root, stem, leaves, bark, flower, fruits, seeds are used as medicine. They can be used directly in raw form such as *Ocimum sanctum* (tulsi) and Mentha arvensis (mint) leaves or indirectly in the form of extraction or decoction. Active components of medicinal plants are used in various systems

of medicines such as Ayurveda, Allopathic, Homeopathic, Siddha and Unani. Folklore etc. for treatment. Worldwide there is a potential market for herbal products from aromatic and medicinal plants.

India exports a good amount of these products and we can exploit this opportunity to fulfil the demand by exporting organically grown products. Area under organic cultivation in India has increased in the last two decades. India stands 8th in the world in terms of net area under organic cultivation with 1.78 million hectare according to ICAR Annual Report 2021-22. Sikkim and Andhra Pradesh are leading states promoting sustainable agriculture in India. In 2003, the Sikkim state declared itself a hundred per cent organic state. It has stopped the import of chemical fertilizers. Other states have also started to encourage organic farming supported by various state and central government initiatives. For example, Chhattisgarh's 'Godhan Nyay' Scheme promotes organic farming and supports rural livelihood.

Organic farming is an eco-friendly and safe practice to grow nutrient rich food. Government is also taking steps to reduce chemical fertilizers and promote organic farming at various forums. For ease of marketing the organic products, the Agriculture ministry launched a Jaivik Kheti web portal to connect organic buyers and sellers.

Participatory Guarantee Scheme to certify organic products like oil seeds, pulses, cereals, millets, tea, coffee, fodder, cotton aromatic and medicinal plants. Among organic producers Madhya Pradesh grows mainly soybean, wheat and vegetables and has the largest area under organic cultivation, followed by Maharashtra, Karnataka, Uttar Pradesh and Rajasthan.

2.6 Advantages of Organic Farming

2.6.1 Soil health: Organic farming practice promotes the growth of various types of soil microorganisms that can fix atmospheric nitrogen solubilize phosphate for plants. Growth of Rhizo bacteria, Actinomycetes, Vesicular-Arbuscular Mycorrhiza(VAM) and other fungi are also promoted in soil by added organic matter. It promotes microbial diversity in soil thus improves soil quality and fertility. Soil microbes play an important role in nutrient recycling and are important for maintaining the soil quality and fertility.

Toxic chemicals used in conventional farming kill microorganisms thus adversely affecting the soil quality and reducing the fertility potential. Organic matter (plant and animal residue) also improves water holding capacity and fertility of soil.

2.6.2 Reduced pollution: Chemical Fertilizers, insecticides, pesticides and fungicides all are potent sources of pollution. These chemicals may enter the food chain through plants and

contaminate the soil, water bodies and whole ecosystem. Organic farming discourages the use of harmful chemical fertilizers, insecticide, pesticides and growth hormones. Thus eliminates entry of harmful chemicals into the ecosystem and protects nature from being polluted.

2.6.3 Mitigating global warming effects : Organic farming is reported to reduce emission of greenhouse gasses and resilience climate change. It promotes proper soil and water management protects diversity of nature. Positive contribution of organic farming regarding climate change has been reported however at present data is insufficient (Khanal2009).

2.6.4 Health of ecosystem : Organic farming is chemical free practice of growing food. It provides healthy food and clean water thus maintains the health of all organisms and ecosystems. Organic farming protects planet earth and supports life to sustain in a healthy way. It promotes biogeochemical cycles in nature to recycle nutrients and supports biodiversity to ensure sustainable living.

2.6.5 Energy efficient and economic practice : A significant amount of energy is required for manufacturing synthetic chemical fertilizers. Organic farming does not require synthetic chemicals thus the practice of organic farming is more energy efficient. Most of the organic matter added to soil is either free or cheap. It promotes utilization of locally available resources like crop residue, cow dung manure and domestic wastes thus utilizing less energy. Further, no chemical fertilizers or insecticides are used. Weeds are removed using mechanical methods. No chemical herbicides are used.

2.6.6 Healthy and safe food : Organic products are nutrient rich, healthy and safe. Practice of organic farming not only reduces pollution but also provides quality food and healthy space to live for animals.

2.6.7 Utilization of local resources : Organic farming promotes utilization of locally available resources and also provides an employment opportunity in rural areas. Local varieties grow well as they are adapted to particular region. This also helps to ensure crop diversity.

2.6.8 Biodiversity conservation: Conventional agricultural methods pollute the natural habitat of living beings and destroy the heterogeneity of nature, by adding toxic chemicals, whereas natural farming practice helps to keep all living beings in harmony thus promoting biodiversity. It also conserves local varieties as they are well adapted to grow in the local climate. This practice conserves wild flora and fauna by providing them natural habitat.

2.7. Challenges of Organic Farming

7.1 Availability of organic matter : In India crop residue is generally used as fodder and fuel instead of used as mulch or making organic manure. The livestock population is also declining with increasing urbanization. Availability of sufficient and cheap organic matter is one of the challenges especially in agriculture areas close to cities.

7.2 Lack of awareness: Many farmers are not aware of the harmful effects of synthetic chemicals. Many times they apply more than required quantities of fertilizers and insecticides without realizing that excess can be disastrous. Knowledge and availability of different types of organic manure, Productivity of organic farming is lower than conventional farming which may affect farmer's income.

7.3 Off season crops: People enjoy off season fruits and vegetables and are ready to pay more for it. Organic farming is good for growing seasonal crops and it is difficult to grow off season crops which are easily grown with conventional farming using modern techniques to gain more profit.

7.4 Limited storage and Transportation facilities: Besides food grains, fruits and vegetables share a good part of organic cultivation. Food grains can be easily stored and transported but for perishable produce like fruits and vegetables need good storage and transportation facilities to reduce the disparity in supply and demand.

7.5 Higher price of organic products: Organic products are more costly than conventional products. A small section of urban population is conscious and aware of the benefits of organic products and willing to pay for it, however, the majority of customers still opt for cheaper products.

7.6 Appearance of produce : Colour and texture of organically grown fruits and vegetables are less attractive, therefore for the good sale of organic products and more income people must be made aware of its benefit for them and the environment which is equally important for all of us to sustain and live a healthy life.

7.7 Certification: It is essential for authentication of organic produce and price margin in the market. There is less awareness regarding the process of product certification and without this farmers will not be able to get the proper price for their produce.

7.8 Acceptability: People still prefer good looking and cheaper food products as there is less awareness regarding the quality and health benefits of organic food. It will take time to

increase social acceptability for organic products then farmers will get proper benefit for their produce.

8. Strategies to Promote Organic Farming

8.1 Agro-tourism : Organic farming can promote sustainable tourism development which will provide an opportunity to earn more besides farming. Agriculture tourism can be a promotion strategy for organic farming as a new concept gaining attention nowadays. It will involve more young population in agriculture and environment and create more job opportunities to promote the development of rural areas and boost local economy.

8.2 Growing crops with export potential : Local crops with export potential should be selected for more profit. Major organic products exported from India include tea, rice, cotton, wheat, spices, coffee, cashew nut, fruit and vegetables.

8.3 Availability of Support system: A network of systems to be created for guiding, branding. Retailing, packing and labelling of organic products for farmers are important factors. Attractive packing can be done using organic waste that will promote the marketing.

8.4 Creating awareness : Educating everyone and creating awareness will be an important step in this direction. Knowing the benefits is important before starting. Once we understand the value of healthy food and a clean environment for the quality of life people will be automatically promoted to shift from conventional to organic farming.

9. Success Stories

9.1 Shri Dhwaj Pal Singh: A farmer from Dadri village, Panwari block of Mahoba district was involved in traditional agriculture before 2005. He shifted to organic farming after taking training from Krashi Vigyan Kendra Mahoba UP. He has produced organic tulsi, chia seed, shatavari, pigeon pea, chickpea, mustard and wheat etc in his farm. He has organic certification from Agricultural and Processed Food Products Export Development Authority India. He was awarded by the Organic India Company as 'Dharti Mitra' award.

9.2 Samir : A graduate (BSc Agriculture) from Assam created an organic model for promoting organic farming in the north eastern states in 2005. He gathered farmers to start organic farming in his area. Samir moved forward to start a venture called "YATRA" in 2010. His idea of developing organic model villages and initiating farm tourism added to his income and provided job opportunities for local youth. Tourists prefer living in the village farm houses, bamboo huts, sailing in bamboo boats, visiting tea gardens and enjoying handmade tea and seeing the culture of the north east. 'YATRA' gives them an opportunity to stay in a

village farm house and experience the raw nature of rural India. This package also involves tracking and meeting with the Forest man of India, Padma Shri Jadav Payeng in his forest. YATRA conducts educational tours for school children to see the organic farming activities and understand the significance of organic farming.

10. Learning Lessons from Srilanka

Number of researches revealed that organic food products contain less pesticide residue and are rich in nutrients, antioxidants and better for human health. The Sri Lanka government banned use of synthetic chemicals and fertilizers through gazette notification in 2021. It aimed to provide healthy and safe food for citizens and reduce adverse effects on the environment. When the whole country was under organic farming it affected the production and people faced a food crisis.

Though the Idea of organic farming is well intended, a sudden shift to organic farming is not recommended. There must be proper planning and precautions before complete shift. We know that the production under organic farming is less than conventional farming. Low yield of organic farming must be considered before shifting the whole nation to organic farming. One must create appropriate infrastructure and maintain the supply chain of inputs. Farmers should be educated and made aware of the consequences of organic cultivation and there should be gradual shifting with adequate precautions.

11. Future of Organic Farming in India

Agriculture is the backbone of India where more than 68 % people are directly or indirectly involved in agricultural activities. Organic farming is based on the principle of maximum production without harming the soil quality, environment and ecosystem. Government has already taken initiative to promote natural farming in India for food safety and is encouraged as a restorative measure for natural resources.

Organic Farming has also been supported under many government schemes such as Rashtriya Krishi Vikas Yojana (RKVY) to promote public investment in field of agriculture and to develop farming as main source of earning. Mission for Integrated Development of Horticulture (MIDH) is to promote overall growth of the horticulture sector and to increase farmer's income. Despite government support, organic farming currently covers only two per cent of the country's total net sown area (140 million ha).

According to the Economic Survey 2022 the government is intending to promote research and development in the field of organic farming and agriculture. Farmers are promoted to

adopt organic farming through various schemes are launched by the Indian government that includes National Mission for Sustainable Agriculture (NMSA) to make agriculture more productive, sustainable and climate resilient by adopting conservation strategies for natural resources and promoting location specific integrated farming.

Rashtriya Krishi Vikas Yojana (RKVY) started to develop agriculture as the main source of livelihood by minimizing the yield gaps and promoting the investment in this sector. The government has also developed a nationwide awareness program called National Program for Organic Production (NPOP) to create awareness about organic products and their benefits. The Union government launched Paramparagat Krishi Vikas Yojna (PKVY) in 2015 to encourage organic farming in India.

Agriculture ministry launched Bhartiya Prakritik Kheti Paddhati (BPKP) which promotes traditional indigenous practices. The scheme highlights exclusion of all synthetic chemical inputs and promotes biomass recycling, biomass mulching and use of plant based preparations. Farmers are switching over to organic farming practice for producing food for health and environmental reasons. India is one of the potential organic food producers with about two million certified organic producers.

12. Conclusions

Sustainable development goals require nations to adopt agricultural practices that improve land and soil quality and protect the genetic diversity of flora and fauna. The significance of organic farming lies in its role in minimizing the environmental pollution and restore ecosystem services. It provides nutrient rich and safe food and also protects the environment from harmful effects of toxic chemicals. Market for organic products is growing very fast worldwide.

In the last few decades aware consumers preferring organic food products therefore demand and popularity of organic foods is growing day by day. Encouraging this natural farming practice will ensure healthy ecological and economic growth of India. Ideas applied with traditional knowledge and modern techniques opening new doors. New ideas like connecting organic farming with agro-tourism not only helping in conserving Indian traditions but also making people aware of its benefits. It is also offering job opportunities to young generation to earn while working in their own locality. Some failures in adopting for organic farming are adding to our experiences so that we move forward with better planning and success stories lighting hope that sustainable goal can be achieved through planned and careful introduction of organic farming.

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CHAPTER - 03

Organic Farming: Concepts and Strategies of Organic Plant Breeding

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3.1 Introduction

The worldwide umbrella organization International Federation of Organic Agriculture Movements (IFOAM) defined to organic agriculture. Organic agriculture is a production system in which scientists and plant breeders consider high yield, without losing effect of soil health, people and ecosystem, biodiversity and their components and without using of inorganic chemicals, synthetic chemicals and pesticide etc. Organic agriculture also promotes fair relationships in the value chain, reflected in IFOAM's four basic principles of Health, Ecology, Fairness and Care. IFOAM defines "sustainable" as meeting the needs of the present without compromising the ability of future generations to meet their own needs, conserving an ecological balance by avoiding depletion or destruction of natural resources.

Organic farming produce lower yield than conventional breeding but it is more eco-friendly, profitable for human health and provides good nutritional value to human diet. Present time organic production is based on the modern societies depend on the varieties that bred for the conventional breeding high-input sector where nitrogen fertilizers and synthetic chemicals for pest, disease and weed control are not a limiting factor. However, in organic farming system, we cannot use any transgenic, genetically modified varieties, etc.

It improves to soil fertility through use of appropriate organic culture, organic products and local nutrients. Organic food chains are well organized in developed markets, organic farming is still germinal. They often organize access to local markets as part of a Participatory Guarantee System (a system depending on mutual control within a farm community or group of farmers) or, as a second step, they can profit from high value export markets. The organic sector is continuously developing and improving its farming and processing methods and where appropriate will adopt new strategies when they comply with the norms and

standards. Specifically in the field of plant breeding, there are different perceptions in societies on the suitability of modern breeding techniques such as genetic engineering (GE), especially for organic agriculture. The controversies around whether or not the organic sector should adopt certain modern breeding techniques can be considered such a “messy” problem, as there are not only technical aspects but also different opinions on values at stake.

3.2 The Concept of Organic plant breeding

The aim of organic plant breeding is to develop plants, which enhance the potential of organic farming and biodiversity. Organic plant breeding is a holistic approach, which respects natural crossing barriers and is based on fertile plants that can establish a viable relationship with the living soil. An organic variety is a variety obtained by breeding methods that are in compliance with the above concept and is the result of a certified organic plant breeding programmers. Organic plant breeding is a relatively young and growing discipline described as either plant breeding for organic agriculture or plant breeding under organic conditions. While organic seed production and selection of varieties suitable for organic farming goes back to the 1970s in the United States and Europe, organic producers were not obliged to use organic propagated seed, let alone organically bred varieties.

Organic seed and planting material are multiplied or propagated for at least one generation under organic management. They are origin from varieties that are resultant of (conventional) breeding programmes with the possible help of all kinds of permitted breeding techniques for organic agriculture, including the field and some in vitro techniques. Although organic regulations from the start stated that organically produced seeds should be used when available, only since 2004 has the European Union (EU) regulation made it more difficult to receive exceptions for use of conventional seed and the use and production of organic seed is now actively promoted in most EU member states. While it is well established that organic production systems represent different growing environments compared to conventional systems, and that genotype x production system interaction is an important consideration, we do not have adequate knowledge of what components of an organic system are most important and what varietal traits allow optimal adaptation to such a system. Organic farming starts with breeding.

Organic plant breeding is defined by the IFOAM standard (4.8 Breeding of organic varieties) and bears a high potential to provide farms with varieties perfectly adapted to organic farming. Organic plant breeding contributes to the organic farming goals such as the work in

accordance with biological systems and to have a positive impact on biodiversity – as organic breeders work with a broader genetic base than conventional breeders do.

Organic plant breeding is important for farmers and human health because it is not affected or losing to environment and human health. In which, control of inorganic and synthetic chemicals such as pesticide and insecticide synthetic soluble fertilizers and veterinary medicines, organic farmers rely heavily on preventive and system-oriented practices. Varieties developed through organic plant breeding and multiplication of seed production through use of organic plant breeding. In organic farming the characters competitiveness against weeds, nutrient efficiency and tolerance to diseases are in the choice of a variety of much higher importance than in traditional farming. The tolerance to diseases is both in organic as in traditional farming of growing importance.

All varieties of which seeds or propagation material have been propagated under organic growing conditions are currently allowed in organic agriculture, provided they are not declared as genetically modified varieties (European Commission, 2007). According to a derogation rule, untreated, non-organically propagated varieties are only permitted, if no suitable varieties from organic propagation are available. Among the currently available varieties the following categories can be distinguished :

1. Varieties derived from conventional plant breeding that are suitable for organic farming with the exception of genetically modified varieties (conventional breeding, organically propagated, or, if necessary, derogations are made for conventionally propagated but post-harvest untreated seed).
2. Varieties derived from plant breeding programs with a special focus on the breeding goals or selection environments for organic farming, and organic seed propagation (product-oriented breeding for organic farming, organically propagated).

Varieties derived from organic breeding programs or organic on farm breeding, which have been bred under organic farming conditions considering to the above mentioned criteria (process-oriented organic plant breeding, organically bred and propagated).

Organic agriculture is a rapidly growing sector worldwide. A total of 72.3 million hectares were organically managed by 3.1 million organic producers at the end of 2019, which is 1.5% of the worldwide agricultural land. The global sales of organic food and drink reached 106 billion Euros in 2019.The highest organic share of total agricultural land, by region, is in Oceania (9.6 percent) followed by Europe with 3.3 percent and Latin America with 1.2 percent. In the European Union, the organic share of the total agricultural land is 8.1

percent. The country with the highest organic share is Liechtenstein, with 41 percent of its agricultural land under organic management. In the other regions, the share is less than one percent. Many counties reported a significant increase, for instance, India (18.6% increase; over 0.36 million hectares, or 1.6%, more were reported with 2018.

A plant breeding system for organic production should be based on the organic concept of plant health and on the organic position on chain relationships. An essential element of organic farming is that it looks at agriculture as process based on a complex intertwining of agro-ecological, socio-economic and ethical principles. In addition, organic farmers are certified based on their farming process. Hence, organic farming looks at the breeding of new varieties in a holistic way. Thus, not only the variety characteristics itself but also the process of varietal development must comply with the guiding principles of organic agriculture. Schaart and coworkers (2016) analyzed the values of the organic sector and have played a role in developing evaluation criteria and deciding what plant breeding strategies and techniques suit best for the further development of varieties that are adapted to organic farming systems. They also discussed the so-called novel breeding techniques, sometimes also referred to as new plant breeding techniques and the future requirements and challenges of organic breeding to meet the needs of this sector.

3.3 Need for Organic Plant Breeding

Organic plant breeding is still a small sector and the varieties used in organic farming are mainly derived from conventional plant breeding. This means, many varieties used in organic farming are quite old. Many “modern” varieties used in organic are selected under mainstream conditions using seed treatment, herbicides and mineral fertilizers. However, the organic sector needs varieties bred for low input farming, adapted to local conditions and often aims for specific food qualities. Organic plant breeding often goes hand in hand with the conservation of traditional and local varieties – which is an important activity to keep a broad range of genetic resources alive. Nevertheless, conservation must not be confused with organic breeding, which is essential to provide organic farmers with modern varieties suited to serve the present organic food sector.

In a recent published vision of IFOAM called “Organic 3.0” it was estimated that the organic sector could potentially grow up to 20% worldwide of the total agricultural area. For many years, the organic sector was considered the frontrunner of sustainable agriculture and the spin-off it had to the development of sustainability in conventional agriculture was the reason at the beginning of 2000 for many European governments to invest in Organic agriculture. To maintain that leadership position of the organic sector, IFOAM calls for a

continuous improvement in the sector towards more and more implementing best practices to develop "truly sustainable food and farming systems". This implies an integrated approach to make organic food and farming systems not only ecologically sound, but also economically viable, socially and culturally diverse and transparently accountable. Organic farming systems produce on average lower yields compared with conventional agriculture. However, they are more profitable and environmentally friendly, and deliver equally or more nutritious fruits and vegetables that contain less to no chemical-synthetic pesticide residues, compared with conventional farming. The future challenge is to further optimize the productivity of organic farming systems to overcome the often discussed average yield gap of approximately 20% between conventional and organic agriculture without compromising on long term sustainability. However, other authors discussed that the 20% yield gap does not count for all crops and all regions, as in some cases there is no difference or even an opposite trend towards higher yields for organic crops (e.g., barley, wheat and hay crops). One cause of the yield gap is the fact that organic farmers often apply 50%–80% of nitrogen through organic fertilizers compared to the amount of nitrogen in conventional farming systems. While the nitrogen of organic fertilizer will be slowly released it also prevents nitrate leakage to surface and ground water.

In addition, the limited nitrogen supply also reduces too luxurious growth that could enhance pests (e.g., aphids) and foliar diseases (e.g., mildew) as in cereal production. Another factor of limited yield under organic agriculture is the lack of cultivars adapted to low-input growing conditions without the use of herbicides, pesticides and fungicides. At present, around 95% of organic production in modern societies is based on crop varieties that were bred for the conventional high-input sector where mineral nitrogen fertilization and chemical-synthetic pest, disease and weed control are not a limiting factor. The fact that such varieties are used in organic farming systems does not mean that they are optimally adapted, as often important traits required under organic and low-input production conditions are still lacking. Organic farmers' loose potential yield due to lack of sufficient weed suppression, pest and disease resistance traits in cultivars, such as against downey mildew in onion, late blight in potato and scab in apple. Various pre-breeding programs to enhance such resistances are running and first resistant cultivars are being released.

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3.4 Aims of Organic Plant Breeding

With the advent of new breeding techniques and methodologies, it became clear, that the organic sector needs an agreement on transparent criteria for their evaluation. The European Consortium of Organic Plant Breeding (ECO-PB), being one of the IFOAM member organizations, submitted in 2012 a position paper on the goals and values of organic plant breeding and defined various criteria for the assessment of new breeding techniques. ECO-PB formulated the aims of organic plant breeding as follows:

1. The breeding goals shall match the respective crop species and the needs of the complete value chain of the organic sector (producers, processers, traders and consumers). The breeding goals shall aim at the sustainable use of natural resources and at the same time account for the dynamic equilibrium of the entire agro-ecosystem;
2. Organic plant breeding supports sustainable food security, food sovereignty, secure supply of plant products (e.g., fiber, medicine, timber), and the common welfare of society by satisfying nutritional and quality needs of animal and human beings;
3. Organic plant breeding sustains and improves the genetic diversity of our crops, and thus contributes to the promotion of agro-biodiversity;

Organic plant breeding makes an important contribution to the development of our crops and their adaptation to future growing conditions (e.g., climate change).

3.4 1 Approaches for organic plant breeding:

There are some suitable approaches for organic plant breeding which is very useful for farmers and suggested by Bueren and Struik (2004). These are following and given below:

i. Naturalness
ii. Emotive dimension
iii. Normative dimension

i. Naturalness : Verhooget *al.*, (2003) given the concept of 'naturalness' which indicated that not only use the inorganic chemicals but use the organic and agro-ecological principles as well. Naturalness subdivided in three groups.

a. Non chemical approach
b. Agro ecological approach
c. Integrity approach

(a) Non chemical approach : The Non chemical approach is one of the best approaches to organic agriculture. In this approach will not be used any inorganic fertilizers, chemical pesticide and synthetic chemicals. It is totally based on the organic materials only. This is majorly focused on the use of organic substances in such way that become healthier for human and environment. Consumers having some fear regarding the consumption of chemically applied based food but organic food can be utilized without any doubt. In this approach inorganic substances and chemical- synthetic, have to be replaced by organic, bio product natural ones e.g. seed treatment can be done with Neem oil, tobacco leaf, pyrethrum) physical treatment (e.g. hot water treatment, solar radiation) organic product or involving bio agents (e.g. bacillus spp.).

It is the first phase of conversion or moving on from conventional or chemical based farming to organic agriculture. Eventually the organic based approach is going on sometimes it is not possible to control the major outbreak of diseases and pests so that the alternative only chemicals. In non-chemical approach some traits are improved in plant breeding maximum utilization for human under restricted boundaries of organic touch stone.

(b) Agro ecological approach : In agro ecological approach will have to consider safely environments that means without affecting/altering/ harassment to environment. In agro ecological approach, all agricultural activity directly related with nature or without harassment to nature. During in this period conversion of conventional method to organic

breeding, farmers are applying sustainable agriculture to consider of co-operating with nature. Considerably, to save the environment against the chemicals we should select the variety which is strongly recommended for organic conditions and simultaneously tolerance to insect, pest and disease, for required traits, ability to perform with organic substances, give high performance with low use of other product, deep rooted characteristics and produce healthy seed.

(c) Integrity approach : Organic plant breeding mainly allow to develop a genotype which is eco-friendly and higher yielder and species-specific expression potential with quality traits. Therefore, organic agriculture balances the environment without affecting the living life and through providing the quality crops.

3.4.2 Emotive dimension (attitude) : Emotive dimension remove all fears from farmers that kept in mind that chemicals affecting to adverse effect on human health. So, particularly did not use any chemicals in organic plant breeding. There is need promising variety which is adaptable to variable environment with high yield under organic conditions. Farmers should treat the seeds with organic substances before sowing that will also improves the soil. In this dimension, farmers play important role to maintenance and development of genetic diversity.

3.4.3 Normative dimension : Use of organic substances only in place of chemicals to control insect and pest. We are using in vitro technique to develop plant than only use of organic substances in growing media. Transgenic do not be accepted here due to excess exploitation of micro-organism substances. To develop the variety for organic conditions, the breeding techniques should be applied only in organic conditions.

3.5 Techniques for organic plant breeding

Organic agriculture needs a breeding system, which, as a primary objective, takes into account the complexity and, biodiversity of agro-ecological systems and which works at high levels of plant organization.

In some cases, techniques will have to be further developing to meet these criteria. Organic plant breeding distinguishes itself from the mainstream breeding by focusing on three quality aspects: ecological, ethical and edible.

- **Ecological:** organic farmers require varieties with characteristics that are better adapted to this kind of farming system. The desired variety traits include for instance adaptation to organic soil fertility management, implying lower and organic inputs, better root

system, ability to suppress weeds, high yield level and yield stability. The plant's natural reproductive ability should be retained, thus ensuring the sustainable use of the cultivar. Varieties must be able to adapt easily and independently to organic farming conditions.

- ❖ phenotype and genotype are considered equally;
- ❖ greater genetic diversity within and between varieties enhances the plant's ability to adapt to local farming conditions;
- ❖ broad resistance to disease and pests enhances the self-regulating ability of the organic farming system;
- ❖ new varieties should preferably be selected for (regional) organic farming conditions.

- **Ethical :** The ethical criteria, criteria for breeding strategies and the socio-economic criteria are described in detail in the position paper of the European Consortium of Organic Plant Breeding (ECO-PB, 2012). The ethical criteria to respect the genome and the cell as indivisible functional entity follow the concept of respecting integrity of life, and which is also at the basis of the basic principles of organic agriculture as above described. Therefore, any technical or physical invasion into the isolated cell is refrained from and plant specific crossing barriers are respected, irrespective of potential benefit risk assessments. An important point in the breeding strategy is that organic plant breeders—breeding exclusively for organic agriculture perform all steps from crossing till selection and multiplication under organic growing conditions. On the socio economic aspects, ECO-PB is promoting free exchange of germplasm, transparency of the breeding process, open pollinated varieties instead of F_1-hybrids, participatory breeding involving farmers and the value chain and a plurality of breeding initiatives to enable a more diverse and sustainable agriculture.

  Organic breeding techniques and strategies should be compatible with the principles of organic agriculture, respecting the intrinsic value and integrity of living organisms, including plants. It is the reason why organic agriculture excludes the use of GMO's. Organic plant breeding strategies also imply sustainability of the breeding system. In that respect varieties should not be sterile or patented, so that free exchange of the genetic inputs can safeguard plants for the future, being the cultural heritage of mankind.

- **Edible :** Good organic potato and onion products require higher demands for varieties with good long-term storage potential without the use of chemical sprouting inhibitors. Positive quality aspects include aspects related to the inner quality of products, such as

taste, good structure and vitality. Qualities such as taste, colour, form, nutritional value and keeping quality must be retained and improved;

- **Socio-economic principles of organic plant breeding**
  - ❖ farmers and breeders should work together closely to ensure a mutual exchange of knowhow and experience; farmers' privilege should be upheld;
  - ❖ regulations should be amended to enable the marketing of organic varieties;
  - ❖ there should be a free exchange of genetic seed stock between organic breeders;
  - ❖ legal regulations and requirements should consider organic farmers' interests;
  - ❖ a new financing structure should be developed for an organic breeding system.

The IFOAM (International Federation of Organic Agriculture Movements) started a discussion process in 2000 to outline basic standards for organic breeding. Three criteria were used. First, breeding methods should be based on general principles of organic agriculture (breeds should be fertile and adapted to organic production systems, respect for genetic diversity). Second, they should be possible to inspect and trace them with samples. Genetically modified organisms (GMOs), cytoplasmic male sterility (CMS) hybrids, and F_1-hybrids are traceable, protoplast fusion and artificial mutations are not. Third, they should be practical and definitions should last as long as breeding cycles. The banning of several modern breeding techniques is also discussed. GMO's and radioactive radiation should be excluded because they are also excluded in organic agriculture.

Another culture, microspore culture, and CMS hybrids without restorer genes, protoplast fusion, induced mutations should be excluded, because they do not treat the whole organism as the smallest living unit. Patents on plants, which prevent them from being a free breeding material, should not exist in organic plant breeding. Hybrids are accepted, but bio-dynamic breeders want to ban them as well. DNA marker techniques are accepted if the enzymes used are GMO-free and no radioactivity is used. Embryo culture, ovary culture and *in-vitro*pollination could be also excluded in the future.

- **Participatory plant breeding method**

Plant breeding is a "science-based technology" that aims to deliver improved cultivars to farmers through selection in genetically variable plant populations. Participatory plant breeding (PPB) is just one of numerous methodologies that have been developed to achieve this goal. Specifically, PPB is a process in which farmers and formally trained breeders collaborate throughout various stages of the breeding process, often situating breeding plots in farmers' fields rather than on agricultural research stations, and selecting for agronomic

and quality traits tailored to the farmers' specific requirements. PPB is a form of interaction between breeders and farmers (consultative, collaborative or collegial). PPB methods help to improve local adaptation, to promote genetic diversity, to decentralize plant breeding. Organic breeding is aimed more on adaptation to local growing conditions, whereas conventional breeding concentrates on varieties suitable for wide growing areas. PPB is in accordance with the principles of organic farming.

PPB methodologies have now been thoroughly documented in the scientific literature, and vary significantly based on the project's resources and goals (Figure 1). All share a commitment to meaningfully involve farmers in the breeding process. PPB is often presented as a continuum of participation in which farmers can engage at various points of varietal development, such as setting breeding goals, making initial crosses, selecting among diverse progeny, evaluating experimental varieties, and distributing seeds. In addition, the distinction is usually made between "formal-led PPB," in which control of the project rests with scientists housed at public research institutions, and "farmer-led PPB," in which scientists play a more supportive role in the farmer's project . The selection environment can vary, with centralized PPB projects occurring on formal research stations while decentralized PPB projects take place in farmers' fields.

Goals of PPB projects range from developing improved varieties, often for marginalized areas, to maintaining biodiversity, empowering disadvantaged groups (especially women), and/or reducing breeding costs and breeding timeframes. After years of experimentation with the methodology, users can now follow step-by-step guides to creating a PPB program, such as Ceccarelli's comprehensive Plant Breeding with Farmers: A Technical Manual. Finally, there is no shortage of case studies documenting successful PPB projects in developing countries, and a growing number of examples from developed countries as well.

The success of PPB in producing improved varieties for marginalized farmers around the world has stimulated proposals to use this methodology for breeding adapted varieties for organic farming systems in developed countries. Similar to the situation of farmers in many developing countries, organic farmers often encounter heterogeneous environmental conditions, and lack suitable crop varieties due to minimal market influence with the larger conventional seed industry. In addition, a diversity of management practices are employed within organic farming systems, potentially further stratifying variety performance between farms. According to Atlin*et al.* (2001), PPB programs are most effective when either "the targeted region has specific local requirements or when the cropping system differs greatly from that normally targeted by conventional programs."

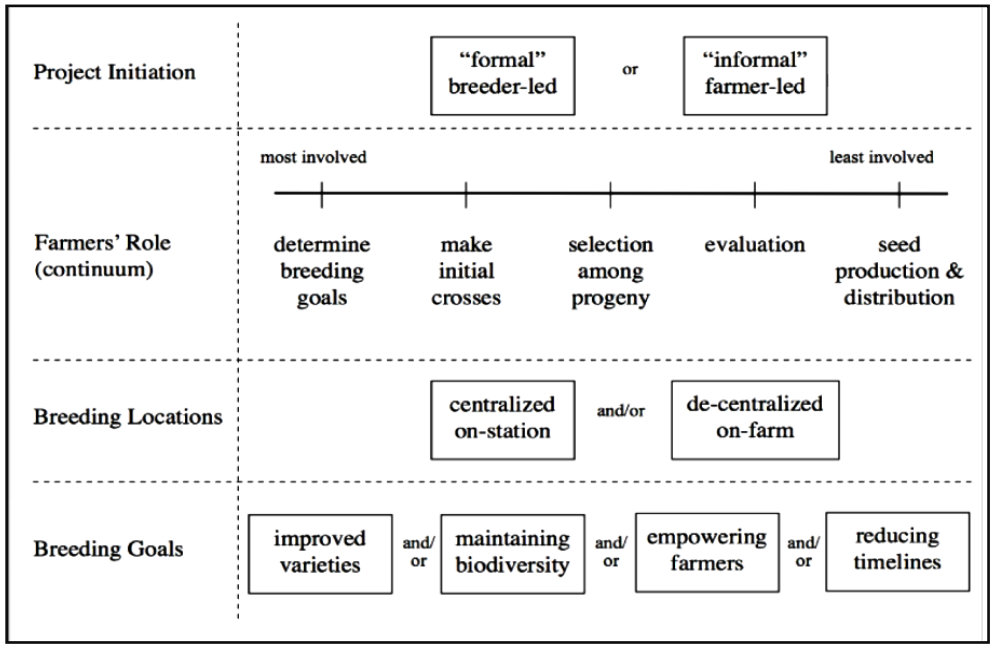

Figure 3.1 : Participatory plant breeding and organic agriculture: A synergistic model for organic variety development

Both of these criteria apply to organic farming. With a strong focus on direct customer sales through farmers markets and Community Supported Agriculture (CSA), organic growers often have different quality requirements than their conventional counterparts. Growing conditions on organic farms also can be vastly different from those found on high-input, conventional farms and breeding stations. Dawson *et al.* (2008) provide a comprehensive literature review of the selection theory used to justify PPB for low-input systems in developing countries as well as low-external-input systems such as organic in developed countries. Much of the theoretical and experimental evidence can be attributed to the work of Salvatore Ceccarelli, who has been using PPB to successfully develop barley varieties since the 1990s at the CGIAR center in Syria, ICARDA.

In essence, selection schemes are most effective when the genetic correlation coefficient between the selection environment and the target environment are high, and the heritability of the traits under selection is also high. Centralized non-participatory breeding programs tend to increase heritability by reducing environmental variance through replicated trials repeated over multiple years and locations, and reducing the error variance by minimizing field heterogeneity through chemical fertilizers and pesticides. Yet these conditions differ greatly from those found on low-input and low-external-input farms, meaning that the

correlation between the selection environment and the target environment is low. As a result, varieties respond differently in the different environments, an example of an effect known as genotype by environment (G x E) interactions.

Centralized non-participatory breeding programs often attempt to minimize the effect of G x E by selecting varieties that are widely adapted through multiple environment testing. PPB allows for direct selection in the environment of intended use, actually exploiting G x E by intentionally choosing varieties that are best adapted to a specific location or production system. In addition to the biological arguments for using PPB, practitioners also stress the value of PPB as democratizing the plant breeding process. To this point, Kloppenburg (1991) states that "it is one thing to argue that the technical knowledge of resource poor farmers should be taken seriously precisely because they are resource poor and therefore not in a position to take advantage of the technologies that science has to offer.

It is quite another thing to argue that farmers who do have the material and intellectual resources to make use of science-based technologies possess – in addition – knowledge that should be used to alter the way science develops and deploys these very technologies." Thus, despite the improved varieties that can arise when farmer knowledge is incorporated into the breeding process, PPB is often met with resistance from institutions because it opposes the traditional structure of public agricultural research.

Of course, offering new research models is precisely part of PPB's value, beyond applying it to develop useful new varieties. All plant breeding methodologies must engage the farmer at some point. Yet this typically occurs at the very end stage of the breeding process, when a variety is released and will either find acceptance or rejection in a farmer's field. PPB fundamentally changes the role of plant breeders through active farmer participation in the entire breeding process.

No longer is a breeder developing new varieties for farmers, but he/she is developing varieties with farmers. The power dynamic shifts considerably with the recognition that both breeder and farmer have equally valuable, yet critically different, perspectives to contribute to the process. Coming from the social science traditions of science and technology studies and actor-network theory, Chiffoleau and Desclaux (2006) state that "PPB can be interpreted as an innovative socio-technical network" that encourages human and biological diversity by empowering otherwise silent actors. Mendum (2009) goes even further by suggesting that "applying participatory plant breeding methods to a U.S. context could be understood as a radical act of democratization."

3.6 Features of Organic Varieties and Crop Breeding

In general, the characteristics of organic varieties and by extension of organic plant breeding, differ from that of conventional breeding systems and conventional varieties. Organically bred varieties shall be:

- Fertile and able to be propagated under organic (soil) conditions.
- Varieties for organic farming need a higher stress tolerance to abiotic causes.
- Able to compete with weeds. The ability to suppress weeds is an important trait in both cereals and non-cereals.
- Longer straw. Cereal varieties with longer straw often have got more mass of roots, so they have got a higher ability to take up nutrients.
- The best resistance traits are often of no particular benefit as disease pressure in organic agriculture is generally lower. Many traits in varieties bred for conventional agriculture are also required in organic farming, but the priority given to individual traits is often different. A high level of disease resistance is necessary especially with respect to*Fusarium, Helminthosporium, Septoria, Claviceps*and viruses.

  An intermediate level of resistance is sufficient for many biothrophic fungal diseases e.g. mildew, which decrease in importance in organic management systems since disease pressure is generally lower.
- Adapted to organic farm conditions: yield will have lower priority in organic breeding, relative to quality. For organic breeding programmes there is interest in maintaining variation within varieties to allow for buffered response to variation in the local environment.
- It is important to identify the exact balance of characteristics required and not to miss out specific traits altogether.
- Organic plant breeding should be a holistic approach; breeders should respect (functional) genetic diversity and species authenticity (natural crossing barriers).
  - Organic crop breeding produces both commodities and non-commodities output for public sector such as animal welfare and livelihood for farmers.
  - It is also revealed the ecological perspective.
  - Organic plant breeding are improving to soil health, soil structure, micro-organism density in soil (flora and fauna) because, we do not apply any synthetic chemicals and

any inorganic product such as insecticide, pesticide etc. which causes adverse effect to soil. Its product has good marketing value.

- Farmer's practices diversification by producing different commodities for tock, crop and ecological aspects. In many places where organic plant breeding is continuing apply, numerous bees to participate for pollination to crops in larger areas.
- Furthermore, diversified crop rotation or mechanical weeding have a positive effect on the species diversity of organic farms.
- Not all taxonomic groups and some crops profit from organic plant breeding, but maximum variety exhibit production in organic plant breeding.
- Traditional farming depends on chemicals fertilizer, herbicides and pesticide is caused to environment hazard. The result of non-application of chemical based fertilizers on organic crops, which leads to nitrogen leaches from crop field to soil zones that could decrease the quality of underground and drinking water. In organic fields, there are no excessive nutrients elements like phosphorous and potassium that could increase their efficient use in further crops.
- In organic plant breeding continuing use of organic products to enhance to soil fertility in which it does not deteriorate physical property of soil and not affected to micro-organism such as fungus, bacteria, earthworms which is built to soil. There are much more evidence to enhance to soil property through organic plant breeding.

❖ **Not permitted techniques:**

- GMO's
- **CMS hybridization without restorer genes :** Hybrids may have a role in organic farming, provided that the F_1 is fertile and that the parent lines may be maintained in natural circumstances (cms is not applied without a restorer line).
- Protoplast fusion (Organic breeding will not allow techniques that operate below cell level).
- Patenting: patents prohibit free exchange of varieties as input/genitures for future breeding programmes among breeders of other companies, and therefore threaten genetic diversity as a general principle of organic farming and breeding.
- Radiation

❖ **Permitted techniques**

- ***Hybrids:*** From the definition of the concept behind organic breeding hybridization as such can be permitted, provided that the F_1-offspring is fertile and the parent lines can be propagated under organic conditions.
- *DNA marker assisted selection* can be permitted in an organic breeding programme, if DNA screening is performed without enzymes originating form GMOs and without radiation. *Meristem culture* can be used in certified organic breeding programmes because it is considered as being close to classical breeding techniques
- The suitability of different breeding techniques for organic plant breeding based on three ethical interpretations of the smallest living entity – the plant, the cell and the DNA is assessed in the journal "Plant Breeding Techniques: An Evaluation for Organic Plant Breeding". The public discussion about the use of gene-technology has also triggered a discussion in the organic movement about suitable methods used in plant breeding for organic farming. Various breeding methods are used when introducing resistance genes into highly adapted material. Methods involve backcrossing, where defined genes are transferred, recurrent selection involving repeated cycles of inter-mating and selection often used in pyramiding genes in out breeding species and composite crosses used in self-pollinating cereals. In this project the "composite cross" method will be evaluated as a tool for selecting breeding lines with improved resistance.

3.7 Perspectives and Challenges of Breeding for Organic Agriculture

Although organic seed production is increasing annually, specific organic breeding programs are few, and many are focused on cereals. Currently three types of breeding programs are operating :

i. Conventional breeding programs resulting in cultivars (by chance) also suitable for organic farming systems;
ii. Conventional breeding programs aimed at cultivars adapted to low-input and organic agriculture;
iii. Organic breeding programs fully conducted under organic growing conditions.

The organic sector is too small to financially support enough programs to improve a wide range of crops, so the reality is that these three types of programs will run in parallel for at least the next two decades (Przystalski*et al.*, 2007). Another model calls for cooperation of

organic breeding programs with conventional breeding companies and institutes that recognize the need for sustainability and who anticipate developing societal recognition from the contribution that breeding for low-inputand organic agriculture can make.

The organic sector requires a diversity of varieties and needs techniques to deliver varieties that are productive without the use of chemical fertilizers and pesticides. While there is a strong consensus that genetic engineering (GE) is not compatible, drawing the line with regard to novel breeding techniques is not always easy. The debate on specific techniques and products will likely become more complex as new techniques, varieties, and applications are commercially introduced.

Against this background it is clear that the market segmentation will further progress in the future, namely into a segment that produces varieties also useable for the organic sector and another part with varieties that are off limits in organic production systems. The demand for low-input and identity preserved (IP) varieties as alternatives to GE offers an opportunity as well as a challenge for the organic market. While the organic market is growing, productive and high-quality low-input varieties remain limited. Low input and IP varieties create an opportunity to expand the non-GE market, but might also dilute the incentives to breed for organic farming conditions.

The organic seed industry is already challenged and has a way to go to close the loop of the organic production cycle by requiring use of organically produced seed if available. The current variety market segmentation may limit options for organic farmers, reducing their intraspecific biodiversity. There is a consensus that a reasonable transition period is needed to allow the market to adjust to producing an appropriate assortment of new varieties. In the meantime, several product types will co-exist for the organic farmers: (1) organically produced seed from organically bred varieties, (2) organically produced seed from conventionally bred varieties, and (3) in case the first two categories are not available exceptions can be granted for conventionally produced, non-GE seed.

Organic seed production and breeding programs are interrelated but distinct activities. The IFOAM standards distinguish between these two activities. As the sector increases production and use of organically propagated seeds, organic plant breeding also becomes more important. As plant breeders become more aware of the needs for organic farming, breeding activities within the organic sector continue to expand. It is important to find breeders, public institutions, and private companies that are willing to provide the organic sector with suitable propagation material to ensure that the organic market can continue to grow, thrive, and prosper. The organic sector needs ways to stimulate organic breeding

programs and a way to identify varieties from organic breeding programs in the market. A certification system will provide an incentive to breed organic varieties.

9. Other Considerations to Organic Plant Breeding

In many regards, organic production is still a black box, in terms of knowing what traits are important for adapting a cultivar to an organic system. We know in general terms what conditions are limiting, but what the optimal plant traits might be is open to investigation. An example would be phosphorus use efficiency, which can be achieved through mychorrizal symbioses or through developing vigorous root systems that are better at exploring the soil. Both approaches have advantages and tradeoffs, and it is not yet possible to know which is better for a particular situation. There is a need to design more efficient breeding methods for organically adapted crops. Farmer participatory methods have been used in organic plant breeding because when working in a new system, breeders do not always know what traits are important to growers.

Farmer participatory methods can work quite well, especially in situations that empower farmers and lead them to takeover breeding activities, but they have drawbacks in terms of resources required to visit the sites or bring farmers to a central site. There is also a need for breeding methods that can work around techniques or traits that are considered not compatible with organic principles. Examples include cytoplasmic male sterility derived through somatic hybridization and disease resistances developed with the aid of embryo culture. The socio-economic, policy, and legal frameworks to facilitate organic production are currently lacking. The increasing use of utility patents to protect crop varieties (in the United States) and methods (both in Europe and the United States) are limiting germplasm exchange and thereby reducing the rate of genetic progress. The variety registration system in Europe has difficulties in coping with the heterogeneous materials developed by organic plant breeders who seek diversity in their varieties.

10. Conclusion

Organic plant breeding is rising from its infancy, has been maturing as a business, and is becoming a scientific discipline. It is a system that develops the variety, which is higher yielder under organic conditions, which maintain the soil and human being health due to non-application of chemicals. It is contributing not only to the needs of organic farmers who require cultivars better adapted to their farming systems, but also to the development of sustainable agriculture aiming to reduce external inputs. Organic plant breeding is an essential strategy in arriving at such sustainable farming systems. Eventually the yield of

organic variety may be low but that can be addressed through the use of plant breeding techniques under organic soil. The varieties developed through organic plant breeding or varieties cultivated under organic conditions may not have any adverse effect on human health and even familiar to environment also. The next decade may be the era of organic breeding activities and organic agriculture without any yield barrier and other challenges that we are facing in present scenario.

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Dimensions of Livelihood in Rural India

CHAPTER - 04

Renewable Energy Potential in Transforming Face of Rural India

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4.1 Introduction

There is no doubt that India faces a serious energy shortage. Rural India's energy supply situation is substantially worse. Though India is on track to meet its Paris Climate Agreement objective of adding 40% renewable power generation capacity by 2030, (Intended Nationally Determined Contributions or INDCs). We had reached 71.5 GW of installed capacity by July 31, 2018. We've also installed off-grid systems with a total capacity of more than 1 GW.

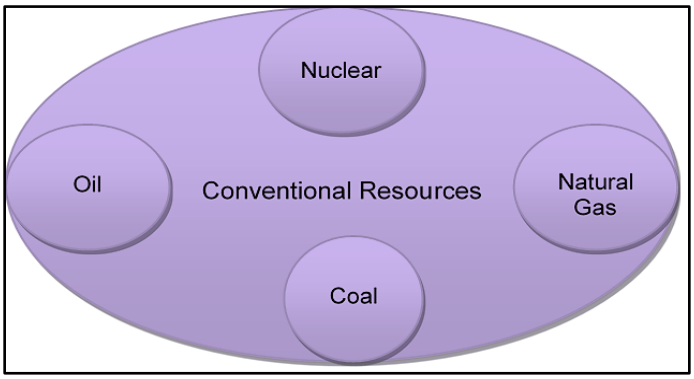
It is incredibly difficult to connect these towns to the electric grid due to their remote geographic locations. According to this chapter, the best way to solve this problem is to use renewable energy sources, especially in rural areas. Many attempts have been made to meet this challenge, but no results have been achieved. India still has a lot of renewable energy potential that has to be realized.

4.2 Energy Resources

There is wide variety of resources available in the earth for energy production, energy resources are classified as renewable, nonrenewable. Energy so

4.2.1 Non-renewable Resource

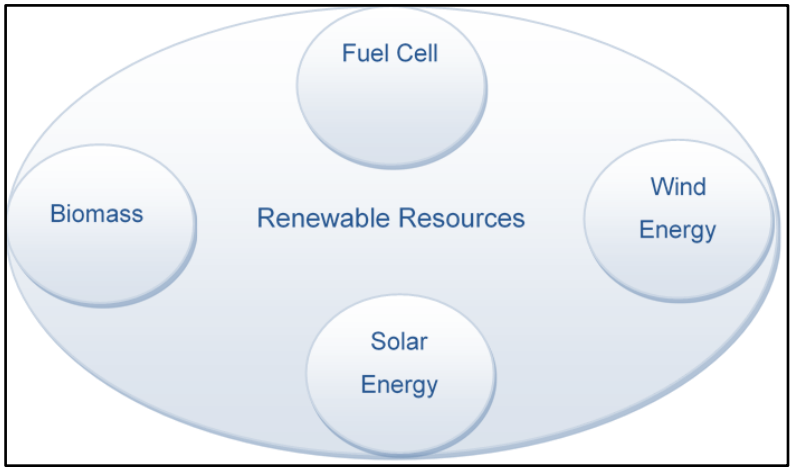
Fossil fuels are the conventional sources or its derivatives are largely used for the production energy. Examples of conventional energy sources are natural gas coal and oil as shown in figure. These constituents on the power



segment present the major player for full figure the world's energy requirement. These conventional energy sources amounts to a huge by live and as they are now limited to as it will take several years for them to be replenished. Hence the term "conventional resources" refers to fuels. Fossil fuels have a significant influence on the environment since its combination is highly harmful for the atmosphere. It emits GHG gases cause climate change and global warming. Because of this reason many of the countries are avoiding the use of the conventional fuels and are searching for opportunities through which we can reduce your reliance on Non renewables

4.2.1 Non-Conventional (Renewable) Energy

This energy which is called as the RESR is constantly getting referred by the natural events that occur without warning. In figure the major RES are depicted that are known as RES. Non-Conventional Energy systems, such as solar, hydro, wind, and biomass energy, are converted into a heat otherwise electricity Majority of this energy is tapped from sun which will not finish and so it is called as renewable. Renewable means the continuous flow of power on the other hand the Energy reserves include nuclear and fossil fuels. By using RES it is going to cause no contamination and it is eco-friendly. These natural resources are considered as sustainable in all aspects as they are naturally available in abundance and there is no cost associated with it.



4.3 The Situation in India Regarding Renewable Energy

India is trying to produce major part of its energy from RES. The renewable power accounts to over 20% of the capacity and monitoring capabilities (69.0 to Giga watts) as on March 31, 2018. On the other hand unlike other countries India is not much into hydro energy because it is motivating the renewable electricity approach to mature MOP (ministry of power) over NMRE (ministry of new and renewable energy). As a result, RES, which include hydro account for approximately 33% of the total Indian installed generation capacity. The 4th biggest

sector in wind power in the word is India, the wind energy potential as recorded on 31st march 2018 was 3404 6.46 megawatt.

Government has put goals of putting 20 Giga watts of solar enabled power by 2022 in advance to the agenda in 2018 it was accomplished all the way by building solar parks and by building solar rooftop photovoltaic panels. Chunav by 2022 Indian Government has set a contemporary aim of achieving a photovoltaic power output of one hundred watts. India 7 biggest solar power plant which consists of the second biggest solar photovoltaic at kurnool, Andhra Pradesh which has the capacity of about 1000 MW. Badala which is the solar park in Rajasthan which has a capacity of 2.255 Gw world's greatest photo wall type monitoring plant.On march 31 2018 the power generated by biomass which is obtained from biomass gasification and gases biomass burning Cogeneration now stands at 8.3 GW.3.98 million was The domestic biogas plants Cost.

4.4 Underneath the spread of MNRE

SECI (Solar Energy Corporation of India) India is home to some of the world's most challenging river potential development applications. Not only that, but renewable electrical energy supplies are on the way to becoming more abundant by 2022. India's wind energy limit is going to get double and the photovoltaic power level is going to increase 15 folds

Table 4.1 : India's History of RES

Source	2014-15	2015-16	2016-17	2017-18	2018-19	2019-2020
Small Hydro	8,060	8,356	7,674	5,057	8,702	9,365
Bio mass	14,943	16,680	14,158	15,251	16,324	13,842
Wind	28,213	28,603	46,010	52,667	62,037	64,638
Large Hydro	128,244	121,277	121,313	125,134	135,140	155,960
Solar	4,601	7,451	12,085	25,870	39,269	50,102
Other	413	268	214	359	426	367
Total	191,026	187,159	204,181	227,972	261,798	294,289
Total utility power	1,105,445	1,168,358	1,236,392	1,302,903	1,371,516	1,385,113
% Renewable power	17.27%	16.01%	16.51%	17.51%	19.11%	21.23%

besides that were present in April 2016. With over 120 countries India is going to become the Pioneer for renewable power utilizations and its position at the heart over its sunshine countries is going to improve and the international solar alliance mission will encourage more technical improvements about the solar power internationally by 2030. India has targeted for achieving 40% generation of its total power through alternative energy resources. According to a plan sketch released by the central electricity authority, non-conventional resources will provide 57 percent of total electricity capabilities by 2027. The aim of India is set to 275 GW of built renewable energy capacity, adding to 72 GW of hydropower, 100 GW of other zero-emission resources& 15 GW of nuclear power by 2027.

4.5 Evolution of Rural Energy in India

Biomass energy is the locally accessible energy for providing the bare minimum of culinary demands in rural areas. Despite the fact that biomass sources contribute less and less to the total energy scenario, they nevertheless account for more than 40% of the country's energy supply. Fuel wood accounts for 65% of biomass energy in rural regions, with agricultural waste accounting for 20% and cow dung accounting for 15%. There has recently been a significant shift towards commercial energy sources due to the increased use of commercial energy sources. As a result, future energy predictions in India do not reflect a commensurate increase in fuel wood use as the population grows. Predictions are tricky at this point.

Furthermore, the stated Energy Policy does not include any funds for rural development. Rural electrification is mostly thought of in terms of energy requirements for agricultural irrigation as part of a larger food security strategy. As a result, the PRIORITY of Rural Electrification was to aid in the transmission of electricity to agricultural pump sets in order to boost land productivity. Household electrification was an afterthought or a byproduct. In the past, rural energy was defined as providing a single connection to a community that was mostly used to electrify agricultural pump sets.

The Indian government has modified the concept of village electrification to include all villages that have been electrified. The Government of India's Rural Electric Supply Technology (REST) project aims to deliver power to rural families, although the stated policy objectives do not include ways to offer energy to the poorest of the poor households 45 in rural areas. If we are to achieve long-term sustainability in rural development with a focus on livelihoods and ways of improving the economic well-being of impoverished households, we must ensure that these households have cheap access to energy. The most

pressing need is for an integrated development approach that uses energy to improve rural households' health, education, nutrition, and economic activity. The most pressing need is for an integrated development approach that uses energy to improve rural households' health, education, nutrition, and economic activity. As a result, in the context of energy use, gender concerns must be handled with sufficient attention. Without an integrated strategy to development and energy end use, it will be difficult to achieve any real integration between energy and rural development. The following are the primary programs/schemes in these areas that are open for participation implementation in all States/UTs. A few of the Rural Energy Programs

- National Program on Improved Chullas
- National Project on Biogas Development
- Community, Institutional and Night Soil based biogas plants program.
- Rural Energy entrepreneurship and Institutional Development (REEID)
- Women and Renewable Energy Development (WRED)
- Biomass Production, conversion & utilization program
- Biomass gasification program.
- Animal Energy Program
- Integrated Rural Energy Program.

4.6 Renewable Energy Potential

With a solid industrial basis and a track record of successful wind technology commercialization, Solar Photo voltaics (SPV), solar thermal energy, and small hydel, India is a leader in biogas and improved biomass stoves. Today, it is in a position to provide other developing countries with "state-of-the-art" technology and to lead the worldwide push toward sustainable energy development. Renewable energy has a lot of potential in India. The extent at which this potential may be commercially exploited will be primarily determined by renewable energy project technologies, finance, and execution tactics. There is a potential exploitation in the order of 1,75000 MW, according to the Ministry of Non-Conventional Energy Sources. Table 3.2 summaries this possibility. The 1973 conflict resulted in a significant increase in the number of people who were killed.

The 1973 Middle East Conflict resulted in a significant increase in the cost of essential inputs agriculture, namely energy and fertilizer, has a negative impact affecting the economic system of nations, both developing and developed The only obvious benefit of this tragic

battle has been the increased understanding of the importance of organic wastes as inexpensive sources of energy and plant nutrients in both poor and industrialized countries.

Table 4.2 : Installed and targeted power capacity

Source	Total Installed Capacity (MW)	2022 Target (MW)
Wind Power	37693.75	60000
Solar Power	34627.82	100000
Biomass Power	9875.31	10000
Waste to Power	147.64	10000
Small Hydro Power	4683.16	5000
Total	87,027.68	175000

A dark might have a silver fleck lining. As a result, the current man-made energy crises created by the actions of a few countries have turned out to be a blessing in disguise. It should be regarded like an amber light, warning of impending danger. Decentralized RETs are especially well-suited to provide electricity to rural areas. Decentralized systems, it has been proposed, can offer local power and thus be designed locally. They also have inexpensive upfront costs (but higher prices per kW installed than centralized technologies) and can assist avoid the costly expenses of transmission and distribution grids. They operate on smaller scales (kWh), are more responsive to local demands, and may be accessed in remote areas because they are close to customers. Furthermore, given the limited performance of traditional national grid-based rural electrification programs in reaching tiny, dispersed rural settlements in developing nations, the option of adopting RETs is particularly essential.

4.7 Benefits/Impacts of RETs

Greater access to household energy and power generated by RETs can have a substantial influence on rural livelihoods. By lowering acute respiratory infection and conjunctivitis, which are typically caused by indoor pollution, cleaner usage of conventional fuels can considerably enhance health. Cooking with more efficient technologies can also have broader health benefits, such as making nutritional choices and boiling water more affordable or likely. Women and children will have more time for education, recreation, and economic activities in particular. Access to electricity can drastically reduce the amount of time spent on domestic chores. Electric water pumps, for example, can supply clean water while minimizing gathering labor.

In rural health clinics, electricity allows for the chilling of vaccines and the operation of medical equipment. Radio and television can be used to enhance educational opportunities

as well as provide enjoyment. Electric lighting produces superior illumination than kerosene lanterns, allowing for more work and study time as well as improved security, comfort, and safety.

Improved health and education, as well as increased time to engage in non-energy activities, are essential objectives in and of themselves. Access to modern energy services, on the other hand, has the added benefit of assisting local residents in engaging in income-generating enterprises. In addition to providing the resources to power local industry, demand for services linked with RETs can assist promote local economic activity.

RETs are used in a wide range of productive activities, from mechanical wind-powered water pumps to motorized grain milling machines. Radio services can provide weather forecasts to farmers and fishers, while telecommunication services can supply agricultural price information to growers. As Steger [13] points out, these applications can result in job creation and improved livelihoods, both of which can lead to large increases in rural production.

4.8 Barriers to deployment of RETs in rural areas

The utility of RETs in rural areas has long been recognized. However, a number of obstacles remain in the way of widespread promotion of RETs as viable alternatives to national grid expansion. Despite the fact that certain RETs have been there for a while, many rural residents are unaware of their presence and how to utilize them. Traditional living and cooking habits continue to reign supreme. A move to RETs necessitates more than just making the technology available; it must also be aggressively promoted and affordable. The cost of installing RETs is usually prohibitive for poor rural residents. Microcredit programs that allow people to take out a loan to pay for the installation of a RET such as a solar PV system are only available in a few regions.

A lack of proper government policy to promote RETs can be a substantial impediment to their adoption. In the Lao People's Democratic Republic, for example, a lack of government backing for pico-hydro has hampered efficient market regulation. Inadequate equipment standards or training are likely to exacerbate the dangers of malfunctioning or poorly built or maintained systems. Governments frequently continue to prioritize grid development rather than seeing RETs as a supplement to a national grid system. As a result, remote and poorly inhabited rural areas are pushed to the back of the line, as grid expansion is highly unprofitable in these places. Furthermore, these groups' lack of political and economic power limits their ability to change the situation.

4.9 Economics of Renewable Energy

People in rural and remote regions generally acquire improved access to energy in three ways : 1) using isolated devices and systems for power generation at the household level as well as for heating, cooking and productive uses; 2) through community-level mini- or micro-grid systems; and 3) through grid-based electrification, where the grid is extended beyond urban and peri-urban areas. Each of these models has advantages and drawbacks.

Advantages of more-centralized models include generally lower per kW costs in areas of higher population density, a higher load diversity and suitability for industrial use. Advantages of more-distributed models include applicability to small and remote communities and urban areas, reduced transmission and distribution losses, the allowance for direct and local private investment, local employment, and increased security of supply, as well as, in some cases, improvements in reliability, speed of deployment, local spill-over costs and reduced environmental burdens.

DRE systems also have benefited from trends of decreasing system sizes, improved system costs and enhanced affordability linked to efficient appliances. This section focuses on the first two (distributed) means of improving energy access. At the household and community scale, DRE technologies include small-scale solar PV and stand-alone lighting systems; wind, biodiesel generators, and micro- and pico-hydro stations for electricity generation; and solar and biomass heating and cooling units and cooking devices. Many of these technologies provide productive or mechanical energy for commercial purposes as well. For the purposes of this section, renewable energy-based micro- and mini-grids also qualify as DRE technologies.

There are various obstacles to renewable energy technology adoption, but there are ways to overcome them. Financial constraints are preventing further adoption of renewable technologies. The most important obstacle is the higher perceived risk involved with investing in renewable energy technologies than competing conventional technologies, as well as the implications of this higher perceived risk. on a technology's market:

- Emerging technology deployment is perceived by capital markets to be riskier than established technology deployment. The bigger the perceived risk, the higher the required rate of return on capital sought.
- The perceived length and difficulty of the permitting procedure is another factor that influences risk.

- Many renewable energy technologies' high front-end, or finance, requirements sometimes provide additional cost-recovery risks for which financial markets demand a premium.

Table 4.3 : Examples Distributed Renewable Energy use for Productive Energy Services

Energy Services	Income-Generating Value	Renewable Energy Technologies
Irrigation	Better crop yields, higher-value crops, greater reliability of irrigation systems, enabling of crop growth during periods when market prices are higher	Wind, solar PV, biomass, micro-hydro
Illumination	Reading, extension of operating hours	Wind, solar PV, biomass, micro-hydro geothermal
Grinding milling husking	Creation of value-added products from raw agricultural commodities	Wind, solar PV, biomass, micro-hydro
Expelling	Products that enables sale in higher-value markets	Biomass, solar heat, geothermal
Transport	Reaching new markets	Biomass, solar heat
TV, radio, computer Internet, telephone to market news, co-ordination with suppliers and geothermal	Support of entertainment businesses, education, access Wind solar PV, biomass micro-hydro	Biomass (biodiesel)
Battery charging	Wide range of services for end-users	Wind, solar PV, biomass, micro-hydro geothermal
Refrigeration	Selling cooled products, increasing the durability of	Wind, solar PV, biomass, micro-hydro

The following are some options for dealing with these financial constraints:

- Low-interest loans or loan guarantees may help to minimize investor risk perceptions.
- Tax credits for renewable energy technology manufacturing during the project's early, high-risk years could be another option.
- Regulatory cost-recovery systems, which currently favor low-cost, fuel-based technologies, can be changed to consider life-cycle cost as a more appropriate indicator of cost effectiveness.

- A more effective redistribution of government R&D expenditure that more accurately reflects the promise of renewable energy technology.

External environmental costs associated with conventional fossil-fuel power generating are effectively valued. In a direct economic analysis based on dollars per kilowatt of electricity generation, fossil fuel-fired power plants appear to be the least expensive alternative currently. This technique of accounting tends to overlook the environmental and social costs of generating electricity from fossil fuels or nuclear power. This type of economic research is still in its early stages of development, but it has made significant progress in recent years.

4.10 The need for institutional support

Despite the potential of RETs to catalyze rural development, widespread acceptance and successful performance have not always followed access to these technologies. For initiatives to improve access to RETs to be sustainable, they must be accompanied by the correct incentives, policy alignment, political and institutional backing, and the development of local technology capabilities – the "know-how" and "know-why". Although the use of RETs as off-grid options for providing power services in rural regions is not new, developing countries and international finance agencies such as the World Bank have traditionally approached increasing energy services through expanding the national grid. A long-term vision of a stable national grid serving the entire population could be appealing. Grid extension, on the other hand, hasn't always proven to be the most cost-effective manner of providing access to rural areas, owing to low population density and higher technical losses as transmission networks grow. Off-grid systems served by RETs, on the other hand, may be the best alternative. For off-grid (less than 5 kW) applications, ESMAP (2007) indicated that RETs can be more cost-effective than conventional generating. Pico-hydro, for example, can deliver power for $0.10 to $0.20 per kWh, which is less than a fifth of the cost of comparable sized gasoline and diesel engine generators.

However, there are several obstacles to using off-grid RETs. Even when RETs are accessible, their affordability can stymie their adoption since they compete with traditional energy sources and activities that do not require a financial transaction. According to others, the minimal influence of rural residents in political decision-making has resulted in policymakers' attention remaining focused on capital cities and economic centers. The usage of RETs is frequently linked to national-level carbon emission reductions, especially given globally recognized targets and incentives like the Clean Development Mechanism (CDM) under the United Nations Framework Convention on Climate Change (UNFCCC).Because off-grid systems are modest and transaction costs can surpass any gains from selling emissions

reduction credits, they rarely receive CDM support. As a result, when compared against grid-based options, they may appear uncompetitive, but there is now more support for combining small projects together to reduce transaction costs. The global concentration of CDM projects indicates a preference for large growing economies such as Brazil, India, and China. However, several small-scale projects have been approved, indicating that tiny rural initiatives may be able to benefit more from this funding arrangement.

Some say that the discrepancy between the energy and rural development sectors' priorities makes overcoming the various challenges involved with RET adoption all the more challenging. RETs are primarily the outcome of a market-push energy policy agenda: modern energy services and electrification are essential for rural development; grid extension is too expensive and time-consuming; and RETs represent a low-cost and environmentally benign alternative. However, this does not reflect market demand: what are the energy requirements of that specific rural civilization in order for it to develop? Parallel investments in other industries are required to take advantage of the potential provided by expanded access to modern energy services. Energy investments should be incorporated into rural development programs to ensure that other sectors have access to modern energy services.

Finally, for RETs to be a long-term part of rural development, legislative support and context-specific technology selection are required to install, maintain, and repair these technologies. As a result, the distribution or sale of technology "hardware" must be accompanied by the development of relevant local know-how: technology "software." In general, rural growth can only be sustained if rural society's current political, economic, and technological foundations can adapt to new forms of life. If RETs are to be a part of this new reality, local residents' ability to manage them is critical. Institutional development must be a significant aspect of programs that use RETs for rural development in order to support this.

4.11 Conclusion

The purpose of this chapter is to show how renewable energy technologies (RETs) might help assists rural development. Rural development can both cause and result in reduced energy poverty. Moving up the energy ladder from traditional to modern energy sources can be accomplished in a variety of ways. Given the likelihood that biomass will continue to be used as the primary fuel for cooking in most rural regions for some time, eliminating energy poverty in this area will need the development of technology that mitigate the negative consequences of traditional biomass use. In other areas, such as lighting, solar PV systems can help rural populations move up the energy ladder by allowing them to transition from candles or kerosene to electricity. RETs can help reduce energy poverty and increase access

to modern energy services in rural regions in a cost-effective and ecologically friendly manner. Higher cooking efficiency, less smoke inhalation, increased safety, and lower fuel wood usage have all resulted from the use of biogas and improved biomass stoves.

Artificial light extended work and study hours, and electricity was used to charge batteries and power mobile telecommunications base stations, so the use of solar PV systems, wind turbines, and pico-hydropower has raised living standards, powered entertainment systems, and provided opportunities to engage in productive activities. Grid extension has a definite role to play in improving access to modern energy services in poor nations, and should be encouraged alongside off-grid RET deployment when possible. The following suggestions are in line with this approach, however they are geared toward off-grid RET applications in particular.

- To ensure applicability and harmonization, RET deployment programs in rural areas should be integrated into larger rural development programs.
- On both the supply and demand sides, an enabling government policy is required to encourage the adoption of RETs in rural areas. Regulation, subsidization, import charges, public awareness campaigns, or a mix of these are all possible kinds of government assistance.
- Given most developing nations' limited national finances and competing sector demands, foreign funding is likely to be required to install RETs and reduce costs.
- Donor funding must be firmly aligned with government policy, and phase-out plans must be clearly outlined, in order to avoid a dependent on donor cash. Mechanisms like the CDM have the ability to encourage RETs in rural regions, especially when multiple small projects are combined.
- It is critical that local supply and demand are established and thoroughly connected in order to leave a sustainable local market for RETs once subsidies and donor support are taken out. While regulation can play a role here, particularly in maintaining quality control and regulating competition, it should be carefully targeted to avoid preventing the establishment of sustainable markets for RETs.
- Suppliers and users can collaborate to improve products and cut costs by sharing knowledge, innovating, and learning.
- Opportunities for knowledge sharing, innovation and learning by suppliers and users can also help to improve products and reduce costs.

- RET deployment involves both hardware and "software" components. Appropriate training in areas such as installation, operation, and maintenance, as well as learning and awareness-raising activities, are essential for creating the local expertise needed for effective and long-term RET use. It is critical to enhance local capability among both technology suppliers and users if rural development using RETs is to be sustainable and low-carbon.

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Dimensions of Livelihood in Rural India

CHAPTER - 05

Creating Employment Opportunities in Waste Management in India

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5.1 Introduction

India faces major environmental challenges associated with waste generation and inadequate waste collection, transport, treatment and disposal. Current systems in India cannot cope with the volumes of waste generated by an increasing urban population, and these impacts on the environment and public health. The challenges and barriers are significant, but so are the opportunities. Solid waste management (SWM) is a major problem for many urban local bodies (ULBs) in India, where urbanization, industrialization and economic growth have resulted in increased municipal solid waste (MSW) generation per person. Effective SWM is a major challenge in cities with high population density. Achieving sustainable development within a country experiencing rapid population growth and improvements in living standards is made more difficult in India because it is a diverse country with many different religious groups, cultures and traditions. Despite significant development in social, economic and environmental areas, SWM systems in India have remained relatively unchanged. The informal sector has a key role in extracting value from waste, with approximately 90% of residual waste currently dumped rather than properly landfilled.

The Press Information Bureau states that the approx. 62 million tonnes waste is generated annually in India & the count of unemployed people in India is reduced to 44.85 Million from 48.26 Million if we compare the data of 2016 & 2014. But this decrease in value of unemployed people is still less to achieve the status of developed and prosperous nation. There is an urgent need to move to more sustainable SWM, and this requires new management systems and waste management facilities. The e-waste sector has also significant potential to contribute to the country's economy and generate employment. The electrical and electronics industry has been cooperating with the government and has shown considerable initiative for handling e-waste responsibly. The electronic waste

sector will create 4.5 lakh direct jobs by 2025 and another 1.8 lakh jobs in the allied sectors of transportation and manufacturing. According to the Associated Chambers of Commerce and Industry of India (ASSOCHAM) approximate 8,500 mobile phones, 5,500 TVs and 3,000 personal computers are dismantled in Delhi every day for reuse of their component parts and materials. In the capital alone, it is estimated that over 150,000 workers are employed in official and unofficial e-recycling units.

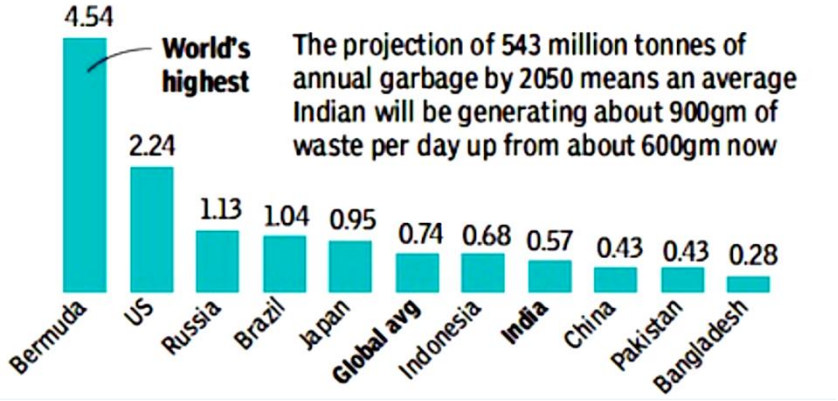

Figure 5.1 : Waste Generation per person per day (in Kg)

5.2 Waste and their Categories

Almost every activity results in the generation of solid waste. India is one of the largest waste generators in the world. On an average, a single person generates an average of 1 to 2 Kgs of solid waste every day. It is estimated that approximately 135-150 Million MT of solid waste is generated every day in India of which only 20% is treated. A clear appreciation of the quantities and characteristics of the waste being generated is a key component in the development of robust and cost-effective solid waste management strategies. Although amongst some of the more developed countries within the region the quantification and characterization of waste forms the basis for management and intervention, elsewhere little priority is given to the systematic surveying of waste arisings and the quantities, characteristics, seasonal variations and future trends of waste generation are poorly understood. Although there is a lack of comprehensive or consistent information, at the country level, some broad trends and common elements are discernible.

In general, the developed countries generate much higher quantities of waste per capita compared to the developing countries of the region. However, in certain circumstances the management of even small quantities of waste is a significant challenge. Throughout the

region, the principal sources of solid waste are residential households and the agricultural, commercial, construction, industrial and institutional sectors.

On several surveys and studies, it was found that it becomes next to impossible to treat solid waste because it is not segregated. It was also found that less than 10% of bulk waste generators segregate waste at source making municipal solid waste management ineffective and/or useless. With the ever rising waste generation, civic authorities have started implementing Waste Segregation at Source. Most of the solid waste generated comprises of daily use items that are found easily in every household. Waste Classification mainly occurs on the basis of their biological, chemical and physical properties and also on the basis of nature. For the purposes of segregation at source, waste is classified in to the following categories:

5.2.1 Municipal Waste

Municipal Wastes are the wastes normally generated from commercial and household activities. They do not include wastes from construction or demolition activities. Open dumping of such wastes contaminates the water bodies. Public health is also threatened as these wastes attract vector-borne diseases. A considerable increase in municipal solid wastes can be seen due to the rising urbanization and lifestyle changes. Urban India generates around 62 million tons of municipal solid waste every year. Note that, municipal waste generates some amount of plastic waste as well. According to the Solid Waste Management Rules, these plastic wastes are first segregated by the generators and are handed over to the authorized rag-pickers or the waste collectors. It is then processed under the guidelines of the Plastic Waste Management (Amendment) Rules, 2018.

5.2.2 Plastic Waste

The accumulation of plastic objects in the environment is broadly termed as Plastic Waste. Plastics come in different forms and the single-use plastics, like the plastic bags, straws, bottles etc, are the ones that are widely used. Since these plastics are non-biodegradable, they are known to disrupt the life of all the living organisms on this planet. Uncollected plastic wastes on land have resulted in the choking of drains, leading to numerous water-borne diseases. Careless disposal of plastic waste blocks the porosity of the soil, thereby affecting soil fertility. Most of the plastic wastes that are not disposed of properly on land, finds its way to the ocean. In the marine environment, these plastic wastes interfere with the food chain of the marine organisms. Roughly around more than 100,000 marine mammals die due to plastic ingestion every year.

5.2.3 E-Waste

E-Waste (or Electronic Waste) are the discarded electrical and electronic products like computers and their peripherals, home appliances, audio or video devices. These products contain toxic metals like lead, cadmium, beryllium, chromium, just to name a few. E-Wastes generally become hazardous when they are recycled or disposed of by primitive methods, such as simply dumping it to the garbage bins. Once exposed to the environment, these toxic chemicals can cause severe health problems. For instance, lead which is usually found in the circuit boards and computer monitors causes damage to the nervous systems affects the kidney and reproductive systems in humans and hinders the brain development in children. Studies have revealed that beryllium, commonly found on the motherboard, is responsible for lung cancer and skin diseases. Printer cartridges that have black and colour toners lead to respiratory irritation. India is the fifth largest generator of e-waste in the world. We generate approximately 2 million tonnes of e-waste annually.

5.2.4 Biomedical Waste

Biomedical or Hospital Wastes are the kind of waste which have been generated during the treatment or immunization of humans or animals in a medical or a research laboratory. This type of waste usually includes syringes, discarded medicines, bandages etc. The discharge of toxins from these bio-medical wastes can gravely affect the terrestrial and marine ecosystems. These toxins, once consumed, can prove to be fatal for some organisms. Human exposure to such toxins can lead to birth defects. Many biomedical wastes can also potentially lead to the spread of infectious diseases. A study recently conducted reveals that India is likely to generate about 775.5 tonnes of medical waste by 2022.

5.2.5 Construction and Demolition (C&D) Waste

Construction and demolition waste is generated due to activities related to construction or demolition of roads, buildings, bridges, subways etc. This type of wastes particularly includes non-biodegradable materials such as concrete, plaster, metal, wood and plastics. A part of this waste combines with the municipal wastes. If such wastes are not managed properly, they can pollute the land and the air. According to an estimate by the government, these wastes generate 165-175 million tonnes annually.

5.2.6 Hazardous Waste

Hazardous Wastes are any kind of wastes which are reactive, toxic, flammable, explosive or corrosive in nature and cause a threat to the health or the environment. Such wastes are

generated by industries involved in the manufacturing of petroleum, paints, pharmaceuticals etc. Unscientific disposal of these hazardous wastes leads to emission of toxic chemicals. These chemicals are responsible for air pollution and degradation of water bodies. Workers employed in such practices suffer from neurological disorders, skin diseases and cancer. As per a report in 2015, India generated around 7.46 million metric tonnes of total hazardous wastes annually.

5.2.7 Battery Waste

The used or depleted batteries from cars, electronic equipment and industries contribute to the battery waste. These batteries contain heavy metals like lead, nickel, lithium, copper etc. Battery waste usually gets unnoticed and archaic methods are relied on to dispose them. Improper disposal of these used batteries results in the release of some toxic chemicals which contaminates both the soil and the water bodies. They can become hazardous to the environment, especially affecting the health of all the living organisms in the world. Every year approximately, 2.7 billion dry-cell batteries are used in India.

5.2.8 Radioactive Waste

Radioactive Wastes forms a part of the waste that contains radioactive elements. These radioactive elements mainly come from mining activities and nuclear power plants. Radiations emitted from this kind of waste are known to disrupt the environment. Such radiations may damage the eyes, injure the skin cells causing sunburns and can have long term effects like cancers and tumours. It has been noted that embryos, foetus, bone marrow and intestinal lining are more prone to radiations. According to a study, India generates around 4 tonnes of nuclear waste per year.

5.3 Waste Management in India

Waste management in India falls under the purview of the Union Ministry of Environment, Forests and Climate Change (MoEF&CC). In 2016, this ministry released the Solid Wastage Management (SWM) Rules, which replaced by the Municipal Solid Waste (Management and Handling) Rules, and 2000 of which had been in place for 16 years. India has drawn the world's attention due to the high-paced growth of industrialization, urbanization, and population. However, another aspect of higher economic development has resulted in increased waste generation and consumption of natural resources, and hence ecological degradation and pollution. As awareness increases of the detrimental effects of currently used waste disposal methods on the environment, accountability is needed for an effective waste management system.

Statistically, urban India produced around 62 Mt of solid waste (450 gm/capita/day) in 2015. Approximately 82% of MSW was collected and the remaining 18% was litter. The waste treated was only 28% of the collected waste, and the remaining 72% was openly dumped. Waste collection efficiency ranges between 70% and 95% in major metropolitan cities, whereas in several smaller cities it is below 50%. Most urban local bodies (ULBs) are unable to manage such a large amount of solid waste due to financial debilities and inadequate infrastructure. Source segregation of waste, doorstep collection, options for recycling and reuse, technologies for treatment, land availability, and disposal competence are a few of the prime challenges. This national policy plays a significant role in the acknowledgement and inclusion of the informal sector (waste pickers) into the waste management process for the first time.

India generates 62 million tonnes of waste each year. About 43 million tonnes (70%) are collected, of which about 12 million tonnes are treated, and 31 million tonnes are dumped in landfill sites. With changing consumption patterns and rapid economic growth, it is estimated that urban municipal solid waste generation will increase to 165 million tonnes in 2030. Effective SWM is a major challenge in cities with high population density.

Achieving sustainable development within a country experiencing rapid population growth and improvements in living standards is made more difficult in India because it is a diverse country with many different religious groups, cultures, and traditions. Despite development in social, economic and environmental areas, SWM systems in India have remained relatively unchanged. The informal sector has a key role in extracting value from waste, with approximately 90% of residual waste currently dumped rather than properly landfilled. There is an urgent need to move to more sustainable SWM, which requires new management systems and waste management facilities. Current SWM systems are inefficient, with waste having a negative impact on public health, the environment, and the economy

5.3.1 Waste collection

Solid waste management has three basic components, namely, collection, transportation and disposal. According to the CPCB, average collection coverage ranges from 50% to 90%. In India, the system of primary collection of waste is practically non-existent as the system of storage of waste at source is yet to be developed, door-to-door collection of waste from household, shops and establishments is insignificant and wherever it is introduced through private sweepers or departmentally, the system does not synchronise further with the facility of waste storage depots and transportation of waste. Many studies on urban environment have revealed that MSW collection efficiency is a function of two major factors:

manpower availability and transport capacity. The average collection efficiency for MSW in Indian cities and states is about 70% in India. The CPCB has collected data for the 299 class I cities to determine the mode of collection of MSW. It is found that manual collection comprises 50% while collection using trucks comprises only 49% (CPCB, 2000).

5.3.2 Recycling

Recycling of (MSW) is now recognised as the 'most environmentally sound' strategy for dealing with MSW following only the preventive strategy of source reduction and reuse. The recycling of MSW is carried out to a very large extent even in the developing countries like India. Informal waste collection by the waste pickers and waste collectors is carried out at several levels such as: the households, commercial establishments, streets, hotels and landfills. Waste pickers and the collectors operate through different modes of transport. The majority of waste collectors regularly use vehicles such as bicycles and tricycles (i.e., rickshaw carts), whereas a major fraction of waste pickers carry a sack and rely on their back and a smaller fraction rents the vehicles according to the requirements of the area.

In India, since there is little in the way of government recycling initiatives, recycling and recovery is usually conducted by the 'informal' sector, which rag pickers place at all levels and at every stage of the waste management stream, and this practice strongly influences the flow of the waste stream, compared with developed countries, there are some districts different in collection of recyclables.

5.3.3 Sanitary landfill

According to municipal solid waste handling rules 2016, sanitary land filling "means the final and safe disposal of residual solid waste and inert wastes on land in a facility designed with protective measures against pollution of ground water, surface water and fugitive air dust, windblown litter, bad odour, fire hazard, animal menace, bird menace, pests or rodents, greenhouse gas emissions, persistent organic pollutants slope instability and erosion".

According to CPCB (2000) on an average, 91% of MSW are dumped in landfills. These landfills are not made according to the stipulated sanitary landfills. Moreover, landfill sites have not been identified many municipalities. More than 90% of MSW in cities and towns are directly disposed on land in an unsatisfactory methods especially sanitary landfill in India. An inefficient construction of sanitary landfill is degrading quality of ground water and health problems in many landfills in India. Availability of land for solid waste processing is very big challenges for many cites in India.

5.3.4 Incineration

Incineration refers to the combustion of waste materials that result in ash residue and air and emissions. Waste incinerations do not eliminate waste, in fact they generate it. Since, physical matter cannot be destroyed an incinerator actually transforms the original waste materials into several new forms including: air emissions, ash and liquid discharge. India's waste has a low calorific value between 700 and 1,000 kilocalories. Therefore, it is not suitable for incineration. The technology for incineration is not available domestically and import options are highly capital intensive. An incinerator plant was established in Delhi during the 1980s and was expected to generate power for the coal grid. However, the operational experience was not satisfactory. The first large-scale MSW incineration plant was constructed at Timarpur, New Delhi in 1987 with a capacity of 300 t/day and a cost of Rs 250 million

5.4 Solid Waste Management Rules

The MSWM Rules 2016 issued by the Ministry of Environment and Forest, Government of India, under the environment (Protection) Act, 1986, prescribe the manner in which the authorities have to undertake collection, segregation, storage, transportation, processing and disposal of the MSWM within jurisdiction. According to the SWM Rules 2016, every waste generator shall segregate waste and store separately and hand over to Municipal workers or authorised waste pickers. Ministry of Environment, Forest and Climate Change shall constitute central monitoring committee to monitor and review every year. Local authorities/panchayats shall prepare SWM plan with time line and its implementation, segregate, adopt 3-Rs, material recovery, processing/disposal of waste, user fee and levy spot fine. As per CPCB recent report out of 1.18 lakh metric tonnes waste generation (82%) is being collected and the remaining 18% is littered. Moreover, out of total collected waste, only 0.33 lakh metric tonnes (28% is being treated and disposed. Solid Waste Management Rules were inaugurated in 2016. Highlights include:

- Waste segregation at source is mandatory. Households are required to separate waste into three streams – Organic or Biodegradable waste, Dry waste (such as plastic, paper, metal, and wood), and Domestic Hazardous waste (diapers, napkins, mosquito repellents, cleaning agents). Further, bulk waste generators such as hotels and hospitals are expected to treat organic waste either onsite or by collaborating with the urban local body
- Municipalities and urban local bodies have been directed to include informal waste pickers and rag pickers into their waste management process. This is the first time that

national policy has acknowledged and included the informal sector into the waste management process. India has over 1.5 million subsistence informal waste pickers and including them into the formal waste management system represents an opportunity for urban local bodies to streamline their operations, while provide the waste pickers with better income opportunities

- Manufacturers of fast-moving consumer goods FMCG that use non-biodegradable packaging are required to put in place a system to collect the packaging waste generated due to their production
- Urban local bodies have been given a provision to charge bulk generators a user fee to collect and process their waste. Additionally, spot fines may be levied on people burning garbage or discarding it in public places
- No non-recyclable waste having a calorific value of 1,500 Kcal/kg or more is permitted in landfills. These wastes should either be utilized for generating energy or for preparing refuse derived fuel. It may also be used for co-processing in cement or thermal power plants.

5.5 Career in Waste Management in India

The demand for professionals in this field has been increasing rapidly in India and across the globe. The prospects of Waste Management in our country have reached its highest level today and the field is considered to be a great career option. However in order to pursue this as a career one has to have a number of degrees, diploma courses, and certifications. There are various degrees, diplomas and certifications available which can help you build a career in Waste Management.

The sector has many job opportunities. Those who want to be a Waste Management Officer (WMO) or be in the decision making scene, will have to show professional degrees in a relevant subject. The key job responsibilities of professionals in Waste Management sector of our country are managing or handling of waste on a regular basis and its disposal in the most safe and convenient manner.

The major roles and responsibilities in this field include working with environmental scientists and experts to come up with the best technologies, plans and strategies for managing and handling the entire country's waste and ensuring it's best disposal. The major employment areas for a career in Waste Management include:

- ❖ Government Organizations
- ❖ Consultancies

- Environmental Agencies
- Non-profit Conservation Projects
- Industrial Organizations

As a Waste Management Professional/Officer, your job description includes:

- Managing and supervising recycling facilities and waste disposal sites
- Managing teams of recycling collectors and services
- Managing private and outsources units
- Frequently analyzing waste and recycling statistics of local areas
- Designing innovative recycling or disposal methods
- Awareness building in local communities and businesses on environmental and waste management challenges
- Handling budgets
- Organize research projects and activities

To be good a professional with the core area knowledge some other additional skills are required like –

- Written and oral communication
- Decision making and problem-solving
- Flexibility
- Leadership and administrative quality
- Organizational skills
- IT knowledge
- Knowledge and awareness on environmental and sustainability issues
- Crisis management

The starting salary for Waste Management jobs in India ranges from Rs. 1,80,0000 to Rs 2,10,0000 annually for professionals in India. The package will be further improved to Rs 2,40,0000 to Rs 3,80,0000 annually at senior level or with many years of experience. An Officer and Operations Manager could also receive more than Rs 3,80,0000 annually.

Waste management officers are responsible for overseeing and coordinating waste disposal, refuse collection and recycling activities in an efficient and environmentally-friendly manner. The recycling business has become a much profitable venture at present. There are many kinds of wastes and types of recycling business ideas depending on the industrial outputs. If anybody wishes to build a career in Waste Management, then you need to be from a science background in class 11th and 12th. There are various universities and colleges abroad which

offer degree and diploma courses in Waste Management. Here are the top courses in Waste Management at bachelor and masters level:

- BSc Waste and Resource Management
- BSc Air Pollution Management and Control
- BSc Environmental Management (Waste, Energy, Water, Oil, and Gas)
- BSc Environmental Pollution Control
- MSc Waste and Resource Mgmt
- MSc Air Pollution Management and Control
- MSc Institution profile for Glasgow Caledonian University
- MSc Environmental Mgmt (Waste, Energy, Water, Oil, and Gas)
- MSc Environmental Pollution Control

If students aim to study courses in this specialization India or abroad, you can explore a wide range of academic institutions. Here are the top universities for environmental and Waste Management in India :

- Awadesh Pratap Singh University Rewa [Madhya Pradesh]
- Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya Chitrakoot Satna [MP]
- Chhatrapati Shahu Institute of Business Education and Research, Kolhapur
- Indian Institute of Forest Management, Bhopal
- Desh Bhagat University, Mandi Gobindgarh
- UP Rajarshi Tandon Open University, Allahabad
- National Institute of Industrial Engineering, Mumbai
- Singhania University, Jhunjhunu
- Hem chandracharya North Gujarat University, Patna
- Global Open University, Dimapur
- IGNOU

Top Universities in the world for waste management related courses are

- Glasgow Caledonian University
- GCU London
- University of Essex
- Tsinghua University
- University of Westminster
- University of West of Scotland
- Glasgow Caledonian University
- University of Northampton

- University of Birmingham
- Kingston University

There is countless business opportunities present in the current waste sector, and these are not restricted to large companies with limitless capital. Small entrepreneurs and SMEs can also tap into the potential that the recycling sector holds

5.6 Conclusion

Waste Management Professionals manage and execute ways to organize the waste collection, disposal, and recycling systems and methods to make the environment clean and healthy. They oversee the activities starting from collecting waste to its final disposition. These activities include the collection of waste generated by household, industrial, and commercial activity to channel the waste from one place to the other where it would be treated or recycled or disposed of. Waste management engineers organize and manage waste disposal, collection, and recycling facilities. They may also be responsible for waste treatment and street cleaning operations. Some posts combine waste management and recycling functions, while others split them into separate jobs. Putting efforts into optimizing collection, processing and treatment of recyclables and waste is not enough; we need to reach out to the production sector and help them create products that are optimally recyclable to the highest possible extent once consumers decide to generate their end-of-life products as waste.

The goal of sustainable waste management is to reduce the amounts of natural resources consumed, reusing the materials taken from nature as much as it is possible, and creating as minimal waste as possible. India's waste management sector is expected to be worth US$13.62 billion with an annual growth rate of 7.17 percent. Waste management is a $1.4 trillion industry globally. U.S. waste management companies account for nearly $100 billion in annual revenue. A postgraduate qualification in waste management or environmental engineering could be useful but is not strictly necessary. It is expected to provide solid waste management skills such as handling, collecting, disposing, storage, transporting, recycling, dumping etc. The key to efficient waste management is to ensure proper segregation of waste at source and to ensure that the waste goes through different streams of recycling and resource recovery. Then reduced final residue is then deposited scientifically in sanitary landfills. The waste management and remediation services subsector is part of the administrative and support and waste management and remediation services sector. In 2020, municipal solid waste landfills had an average tipping fee of $53.72 per ton. That

translates to roughly $1.4 million a year in approximate average gross revenue for small landfills and $43.5 million a year for large landfills just from gate fees.

Industries in the Waste Management and Remediation Services subsector group establishments engaged in the collection, treatment, and disposal of waste materials. Additionally, with the help of both new and existing technology, recycling centers will be able to more easily sort and separate items. An educated public, that also efficiently separates items, will help recycling waste streams become less contaminated and provide more opportunities to be recycled.

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Dimensions of Livelihood in Rural India

CHAPTER - 06

Role of Mass Media in Development of Rural Population of India

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6.1 Introduction

Mass media is nothing but a system by which one can communicate or supply information in order to reflect the true picture or event of the society. Media is the plural form of the word "Medium" and can take a plural or singular verb, depending on the sense intended. Mass media includes every broadcasting and narrowcasting medium such as newspapers, magazines, TV, radio, direct mail, telephone, fax, and internet etc. The term 'media' can also be used as a collective noun for press or news reporting agencies. In this sense, media can play role to educate, aware and effect to mass at a time. Mass media is undoubtedly very fast, vast and powerful mode of communication. Mass communication is any message sent by a person or a group of people through a medium to a large audience, and mass media is any medium used to transmit mass information. Until recently mass media comprised the eight mass media industries: books, newspapers, magazines, recordings, radio, movies, television, and the Internet, however, digital technology has expanded the scope of the term

Figure 6.1: Mass media and communication technologies

mass media. In the current situation, the role of mass media is very import to upgrade the rural society. It can stimulate the rural people towards progress. The mass media have been used at once for transmission of development communications to the people of this society as in others. The mass media included several media technologies that are envisioned to influence large viewers. Broadcast media (also called as electronic media) communicate the facts electronically and include television, radio, movies, and certain other media like cameras and video raise. Alternatively, print media use a fleshly item for sending their facts, such as a newspaper, magazines, brochures, newsletters, books, leaflets and pamphlets (Potter, 2008). Internet media is capable to attain mass media rank in its personal right. The many services such as email, websites, blogging, Internet television are provided by this mass media. In this way, numerous mass media openings have a being there on the web.

TV ads is also type of mass media that links to a website. The internet mass media introduce such programs which are helpful in several way of life of the people. The Internet has enough information which can simply be broadcast to several different areas of the worldwide instantaneously. Out-of-doors media is a usage of mass media that includes ads, symbols, posters internally or externally sited for marketable buildings and items like factories and workshops, airborne posters, airships, and skywriting. Community language and incident establishing can also be measured with the help of mass media.

Basically, more than 70% populations are living in rural areas. They are not much developed. Their development is the need and necessity of our society. Rural development is need of the hour for a country like India, which is on the threshold of being a big power with the capacity to influencing the course of events on our planet. In fact, the essence of development lies not in a regimented system where none dares to disagree but in all- inclusive dispensation in which everyone had an equal role. The quest for rural development must lead us in the direction of empowering those sections of society who are in the need of being empowered. This is the area in which media can and media must play an important role.'

6.2 Problems in Rural Development

Common challenges to unleashing the potential of rural areas include low productivity; underinvestment in agriculture and non-farm rural employment; lack of adequate infrastructure; poor occupational safety and health and working conditions; and limited or no access to services, including financial services. Although media touch the remotest village and try to perform their duties to send the information as earliest as possible but some problems are there to educate, aware and develop the rural society. Problems related to rural development in different level are as follows-

- Individual level
- Family level
- Psychological level
- Professional level
- Agricultural level
- Indian Weather level
- Infrastructural level
- Local area level
- Social level
- Economical level
- Political level
- Cultural level
- Leadership level
- Administrative level
- Media and mass communication level
- Interest level

6.3 Concept of Rural Development

The idea of "Rural Development" is nothing but a process where the standard of living of rural people increases continuously. It may be defined as "improving the living standards of the low-income people living in rural areas and making the process of their development self-sustaining. In fact, the concept of rural development encompasses a wide spectrumin recent years. Significantly in more recent years, the concept of rural development is used in different context which can be shown with the help of following chart

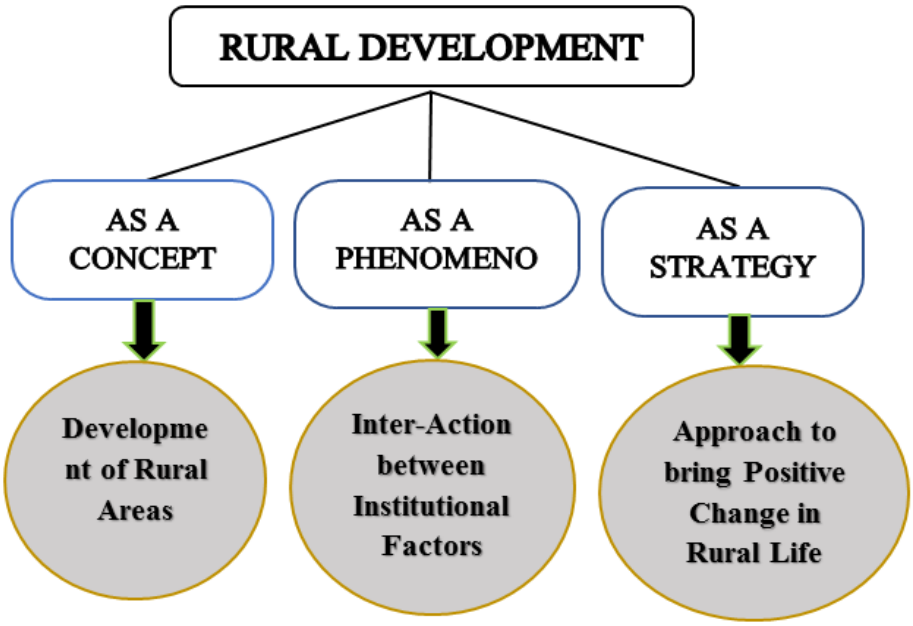

Figure 6.2 : Concept of Rural Development

Concept rural development refers all round development of rural areas including the improvement of lifestyle of rural people; as a "phenomenon" it implies the interaction between physical, environmental, technological, economic, socio-cultural and institutional

factors in the rural areas and as a 'strategy' rural development is nothing but an approach or operational design to bring about desired positive change in socio-economic and cultural life of the people living in rural areas.

6.4 Inter-Relationship between Media and Rural Development

"Media" and "Rural Development" is closely inter-related in the sense that from the era of bullock cart we have traveled down the modern age of satellite technology. The role of media in the process of rural development has been recognized ever since the beginning of planned development in India. In the process of societal integration and development of rural people's lives, media has been playing a significant role in rural development. As information is used as power, so media (Print and Electronics) can play a role in state operations, business operations, environment issues, monetary policy, politics, international affairs, human resources development and investment by providing accurate and dependable information. That is why various sociologist thinkers say that media has become as necessary as food and clothing is in the present-day world. But to understand what role media can play in rural development we have to understand media's role in all its dimensions, i.e., Sociological, Political and Economic dimensions.

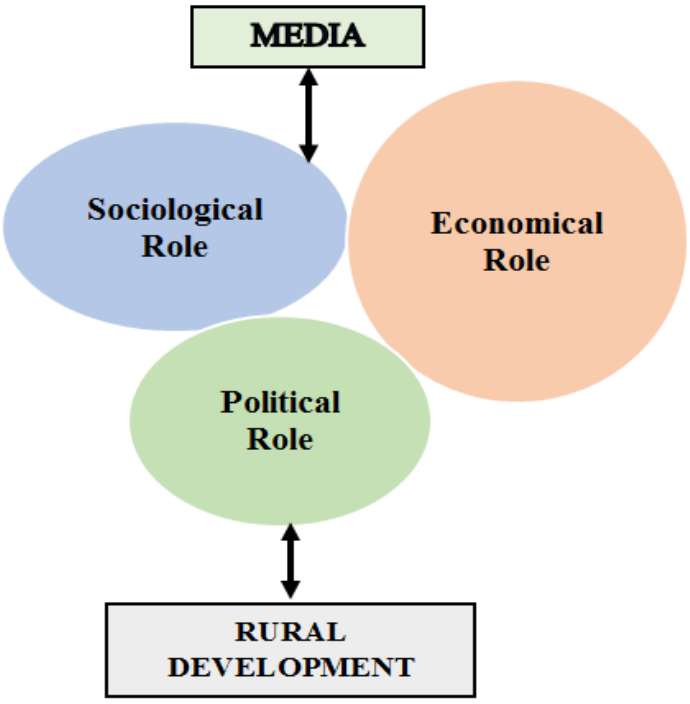

Figure 6.3 : Inter-Relationship between Media and Rural Development

The above loop diagram implies that media can play a significant role in the process of rural development by strengthening and transforming the economic, political and social life of the common people living in the remote areas. For instance, media can play an important role in the economics of rural people by searching alternative ways of making a living. It would reduce the pressure on land and increase family's economic status. It can help in enlarging the market for goods produced in the rural areas and can make the common people aware to broaden the entrepreneurial base and competitiveness among the different classes. In the sociological sphere of activity, media aids in the process of status change of the people from heredity to achievement.

To do this it has successfully motivated illiterate to become literate. Media can help in changing and transforming the traditional ideas into scientific one and thus bring about greater equality and a greater respect for human dignity and make cultural and social change, a self-perpetuating process. With respect to role of media in political field, it can say that media bring about greater equality and respect for human dignity. It motivates the leaders as well as the common people and makes the public know of governments' plans and program for rural development purposes. Media can establish a road to good governance by focusing the dark side of the government in one side, and on the other hand it can increase the efficiency of the government by appreciating the services render to the society through its development projects.

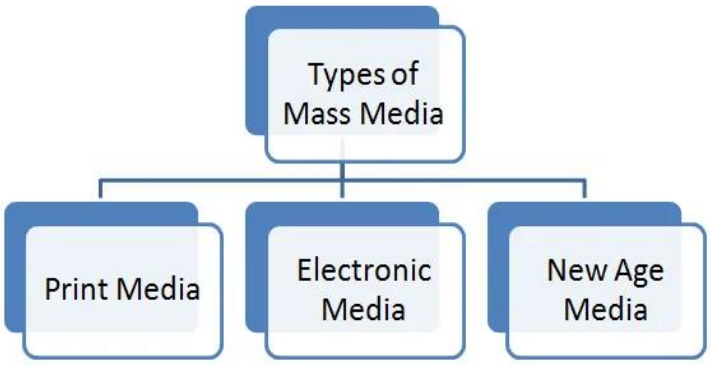

Figure 6.4 : Types of Mass Media

Print media: In print media mass communication is done through printed material. Printed material which includes in print media are:

- Newspapers,
- Magazines,
- Booklets,

- Brochures
- Books,
- Press releases,
- Billboards,
- Handbills,
- Flyers,
- Direct mailers
- Newsletters or periodicals
- House magazines

i) Newspapers: Newspapers were the most preferred medium of media where information can be reached to wider audience. This was the only medium of communication when electronic communication was not there. Newspapers carry information on distinct topics like:

- Stocks
- Business
- Finance
- Entertainment
- Current affairs
- Politics

Newspapers play a vital role in furnishing the following:

- Authentic firsthand information
- In updating knowledge of a reader
- Building opinions

ii). Magazines: These are another type of print media which are very popular. They cover a wide range of topics which are:

- Travel,
- Entertainment,
- Fashion, Beauty, Lifestyle, Luxury,
- Self-help,
- Gadgets,
- Consumers,
- Finance,
- Business,

- Current affairs

iii) Booklets and brochures: These are part of promotional part of an organization or of a product. Booklets and brochures are two types and they are explained in the below diagram:

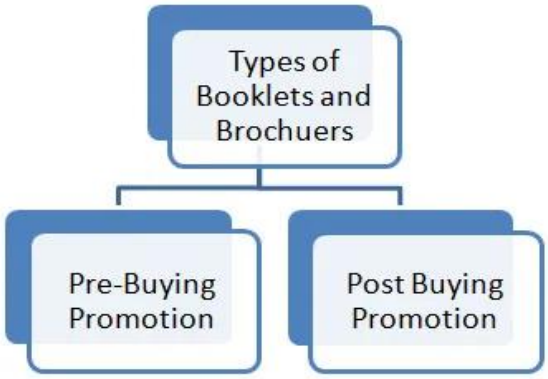

Figure 6.5: Types of Booklets and Brochures

Billboards: these are huge advertisements which are kept at a height that draws attention of people. Billboards target audience with their features like:

- Unique effects
- Designs
- Creativity
- Headlines
- Attention-grabbing
- Bold colors

2) Electronic media: It is a kind of media that needs user to use an electronic connection to access it. This is also called as broadcast media. Electronic media includes the following:

- Television
- Radio and also

i) Television: This electronic device to both visual senses and auditory senses. It is an important mechanism for communication which beholds attention of audience. This category of mass media also includes electronic media like CDs, DVDs, movies, and electronic gadgets.

ii) Radio: This electronic media has also a significant reach. Radio furnishes an interactive means of communication which provides dial-in programs. These dial-in programs provide an opportunity to listeners to feature on radio.

3) New age media: New age media tells about advent of media. With this advent, people are not only enjoying but also taking benefit of the internet which is very fast and has a wide range when compared with old-school mass media. New age media includes the following:

- Mobile phones
- Computers
- Internet

The Internet has modern opportunities for mass communication which are:

- E-mail
- Websites
- Podcasts
- E-forms
- E-books
- Blogging
- Internet TV

The Internet has started many social networking sites. They are:

- Facebook
- Twitter
- Youtube

i) Mobile phones: Mobile phones made communication possible to mankind at any time and from anywhere. A mobile phone is a smart machine which is not only used for interaction but also for technical utilities. Because of mobile phones, at present, we can stay connected with whole world through internet on our phones.

ii) Computers: Invention of computers made the impossible things possible. They have included a modern breakthrough in mass media by combining human intelligence with cutting-edge technology.

iii) Internet: It is a very vital device of new age media. Discovery of this is the biggest invention in mass media. Now it is almost impossible to imagine the life of a person without the use of internet.

6.5 Advantages of Mass Media

There are numerous advantages of mass media in the contemporary world. From being the watchdog of a democratic country to ensuring faster communication, different types of mass media have various advantages and benefits such as:

- **Giving Voice to the Voiceless :** Mass media plays an essential role in shining the spotlight on the masses as the general public can express their views and opinions freely. This way, it becomes the voice of the voiceless thus giving the right platform for the people to use their right to express freely.
- **Effective and Wider Communication :** It is through different types of mass media from social media to the digital platforms that the world has transformed into a global village. This way, mass communication has become useful for the people, businesses, governments and the whole world to stay connected with each other.
- **Diffusion of Diverse Cultures :** Mass media also plays a colossal part in spreading arts and cultures to every nook and corner of the world. With the help of the internet, anyone can learn a new language, know about a different culture or even travel the whole world without physically going from one place to another.
- **Encyclopedia of Information :** The internet is truly a massive open source of information and different types of mass media from search engine platforms to social media platforms and learning websites play a greater role in helping anyone learn anything anywhere.

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Dimensions of Livelihood in Rural India

CHAPTER - 07

Rural Marketing in India : Opportunities & Challenges

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7.1 Introduction

Rural Marketing in India is on a high rise since the past decade, and major multinational corporations want to tap into this potential market which accounts for 70 percent of the Indian population lives in these areas, there is a shift from urban markets into rural markets the reasons for this shift are many, to name a few – the saturation of the urban markets, sudden up rise in the number of rural consumers increasing at a pace faster than their urban counterpart. Rural in India is has many different definitions from the Census of India, the Planning Commission, the Reserve Bank of India. After the green revolution rural marketing and its paradigms have changed through the early 60s to the mid-90s. The rural market and its population is immensely huge, hence with no clear definition. Corporations who want to enter the market need to understand that rural markets are not similar to urban markets in India, to be victorious in the rural market you need to understand the rural consumer first and then sell them your product and services.

Research on Rural Marketing has been of keen interest to scholars because of the methods which various organizations have tried to implement their marketing mix of the Price Place Promotion Product and has developed into the 4As of Rural Marketing as *Availability*, *Affordability, Acceptability* and *Awareness*. The population of the rural consumers in India is more than 83.3 crore according to the Census of India 2011. This is a large market for marketers in terms of numbers, now the only question is how to approach and tap this market. Another aspect of rural marketing can be to look at it as a way of economic development, the initiatives by the government NGOs, Self Help Groups, attribute to the development of these areas along with it, the tie-ups between the corporations and these groups and organizations lead to development of infrastructure, transportation. Rural Marketing presents with challenges and opportunities to a marketer and a thorough understanding of these will help in making more profitable and successful marketing strategies.

Figure 7.1 : 4 As of Rural Marketing

7.2 Rural Market

As per the NC on agriculture: 'Marketing in Rural is a method which begins from a thought for supply of purchasable goods as it also includes every part of the market system, each practical and founded upon technological as well as economic thought & covers both the pre-crop harvest as well as post-crop harvest operations, combining, rating, warehousing, supply and selling. Fast Moving Consumer Goods addresses customer non-durable product needed by people for day to day use. They travel quickly near the sales part. Commonly customers give relatively some time and work while shopping for the product. These are basically products of low-value and high volume. The Fast Moving Consumer Goods industry comprises primarily of divisions viz., personal care and households product.

With the presence of 12.2% of the world population in the villages of India, the Indian rural FMCG market is something no one can overlook. Increased focus on farm sector will boost rural incomes, hence providing better growth prospects to the FMCG sector. Better infrastructure facilities will improve their supply chain. FMCG sector is also likely to benefit from growing demand in the market. Because of the low per capita consumption for almost all the products in the country, FMCG companies have immense possibilities for growth, at present 53 per cent of all FMCGs and 59 per cent of all consumer durables are being sold in rural India. The biggest FMCG Company in India HLL derives more than half of its Rs. 12,000 crores revenues from the rural markets. The rural market is an enigma for the companies. Due to the lack of deeper insights into the psyche of the rural consumers, companies are hesitant to explore this territory. But local brands, like Ghadi detergent in Kanpur, have been able to successfully tap the opportunities presented by rural market. And if the companies

are able to change the mindset of the consumers, i.e. if they are able to take the consumers to branded products and offer new generation products, they would be able to generate higher growth in the near future. It is expected that the rural income will rise in 2010, boosting purchasing power in the countryside.

At present, urban India accounts for 66% of total FMCG consumption, with rural India accounting for the remaining 34%. However, rural India accounts for more than 40% consumption in major FMCG categories such as personal care, fabric care, and hot beverages. In urban areas, home and personal care category, including skin care, household care and feminine hygiene, will keep growing at relatively attractive rates. Within the foods segment, it is estimated that processed foods, bakery, and dairy are long-term growth categories in both rural and urban areas.

Table 7.1 : Phased Evolution of Rural Marketing

PHASE	TIME PERIOD	PURPOSE	MAJOR PRODUCTS	SOURCE MARKRT	TARGET MARKET
I	Since independence but before Green revolution	Agricultural Marketing	Agricultural Produce	Rural	Urban
II	Green revolution to Pre-liberalization	Marketing of Agri-inputs	Agricultural inputs	Urban	Rural
III	Post-liberalization period in 20th century	Rural marketing	Consumables and durables for consumptions and production	Urban & Rural	Rural
IV	21st Century	Developmental Marketing	All products &Services	Urban & Rural	Urban & Rural

7.3 Factors Responsible for Boom of Rural Market

- Increase in population and hence increase in demand.
- A marked increase in the rural income due to agrarian prosperity.
- Standard of living is also growing up in rural areas.
- Large inflow of investment for rural development programmes from government and other sources.
- Increased contact of rural people with their urban counterparts due to development of transport and wide communication network.

- Increase in literacy and educational level and resultant inclination to sophisticated lives by the rural folks.
- Inflow of foreign remittances and foreign made goods into rural areas.
- Change in the land tenure systems causing a structural change in the ownership patterns and consequent changes in the buying behavior.

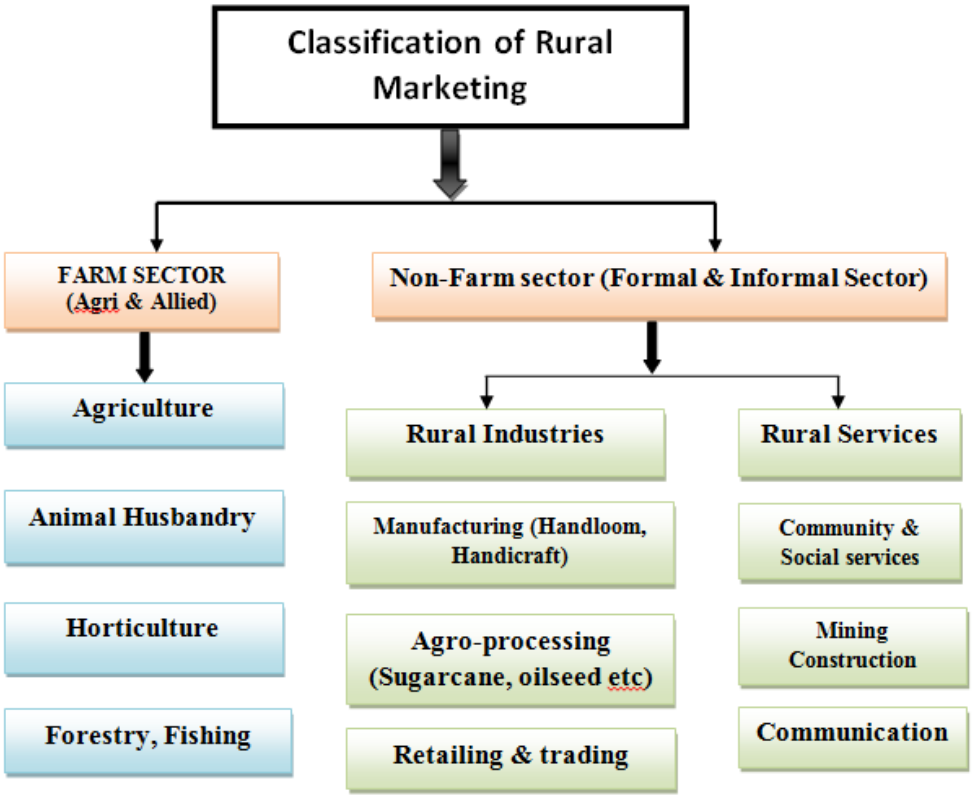

Figure 7.2 : Classification of Rural marketing

7.4 Understanding the Potential of Rural Market

- **Large population**: 742 million Indians constituting 138 million households reside in 6,38,365 villages. The size of rural market itself speaks of its potential
- **Growth in market:** The market has been growing at 3-4% per annum adding more than one million new consumers every year. Consumer is brand loyal and understands symbols better. View it as you may, few people dispute that the rural market is massive. According to Singh, 12.2% of the world's consumers live in India. "Rural households form 72% of the total households. This puts the rural market at roughly 720 million customers." Gupta of TSMG extrapolates the Census 2001 numbers and comes up with

an estimate of 790 million. "Total income in rural India (about 43% of total national income) is expected to increase from around US$220 billion in 2004-2005 to US$425 billion by 2010-2011, a CAGR of 12%," he says.

- **Penetration in rural India:** Today's rural children and youth will grow up in an environment where they have 'information access' to education opportunities, exam results, career counseling, job opportunities, government schemes and services, health and legal advice and services, worldwide news and information, land records, mandi prices, weather forecasts, bank loans, livelihood options. If television could change the language of brand communication in rural India, affordable Web connectivity through various types of communication hubs will surely impact the currency of information exchange. As the electronic ethos and IT culture moves into rural India, the possibilities of change are becoming visible.
- **Impact of globalization:** The impact of globalization will be felt in rural India as much as in urban. But it will be slow. It will have its impact on target groups like farmers, youth and women. Farmers, today 'keep in touch' with the latest information and maximize both ends. Animal feed producers no longer look at Andhra Pradesh or Karnataka. They keep their cell phones constantly connected to global markets. Surely, price movements and products' availability in the international market place seem to drive their local business strategies. On youth its impact is on knowledge and information and while on women it still depends on the socioeconomic aspect. The marketers who understand the rural consumer and fine tune their strategy are sure to reap benefits in the coming years. In fact, the leadership in any product or service is linked to leadership in the rural India except for few lifestyle-based products, which depend on urban India mainly.
- **Increasing income and purchasing power:** The agricultural development programs of the government have helped to increase income in the agricultural sector. These in turn have created greater purchasing power in rural markets.
- **Accessibility of markets:** The attraction of a market depends not only on its potential but also on its accessibility. The road network has facilitated a systemized product distribution system to villages. An increasing number of companies are supplying village markets directly. Increasing direct contacts to villages helps product promotion and availability of the product in the village shop.
- **Consumer behaviour changes:** Increased literacy and greater awareness in rural markets create new demands and discriminating buyers. This is observed more in the younger

generation. In villages today, this segment of buyers consumes a large variety of products, both durables and non-durables. There is a visible increase in the consumption and use of a variety of products, which is easily observed.

- **Competition in urban markets:** Intensified competition in urban markets increases costs and reduces market share. The rural markets are therefore increasingly attractive in relation to urban markets. The automobile market brings this out clearly. Rajdoot motorcycles, Bajaj scooters or Ambassador Cars find ready acceptance in rural markets as compared to urban markets where there is a proliferation of brands.
- **New employment opportunities:** Government schemes like IRDP (Integrated Rural Development Programme), JRY (Jawahar Rozgar Yojana) and TRYSEM (Training Rural Youth for Self Employment) have created new employment opportunities in Rural India. Co-operative banks and Public sector banks are extending loans to rural people, thereby creating job opportunities for them. As a result very few rural people are now flocking to urban centres.
- **Green revolution:** The vision of Dr. Swami Nathan, the father of the green revolution to achieve self-sufficiency in food grain production in 1995, gave a major breakthrough in food grain production by the use of scientific methods in agriculture. At present, Rural India generates 299 million tons annually.
- **Various government policies:** The government‟s stress on self-sufficiency resulted in various schemes like Operation Flood (White Revolution), Blue Revolution, Yellow Revolution, etc. resulted in the production of 15 million tons of milk per annum.
- **Improved exports due to export policy:** The new Export Policy 2000 paves the way for open market (OGL- Open General License System) status for agriculture. The World Trade Organization‟s (WTO) Policy for agro-exports has increased exports of Indian agricultural produce thereby increasing incomes of the rural population.
- **Remittances from Indians working abroad:** These remittances are a sizeable contribution to growing rural income & purchasing power.
- **Political & social changes through favourable government policies:** The Indian Government launched a number of schemes like IRDP (Integrated Rural Development Programme) and REP (Rural Electrification Programme) in the 1970‟s, which gave a boost to the agrarian economy. This resulted in changes in people's habits and social life. REP gave impetus to the development of consumer durable industry.

- **Media:** Mass Media has created increased demand for goods and services in rural areas. Smart marketers are employing the right mix of conventional and non-conventional media to create increased demand for products. The role cable television has been noteworthy in bringing about the change in rural people's mindset and influencing their lifestyles.

Managerial Implications

- **Opportunities in Rural Marketing**
- **Challenges in Rural Marketing**
- **Reasons for companies to go Rural**
- **Key Decision Areas**

A) Opportunities in Rural Marketing

1. The Indian **Government** took a lot of steps to supply and renovate infrastructure of some areas due to which it will be help to increase factor impact in distribution of products, goods and other services which will in return increase the income after rising consumption.
2. Multinational companies such as Flipkart, Snapdeal and Paytm have signed Memoranda of Understanding (MoUs) with the government of India to succeed in areas with the help of regional centers which are constructed in villages which comes under the 'Digital India' initiative.
3. The demand for skilled labors is increasing day by day therefore the government decided to train more than 500 million individuals by the year 2022 and is searching for MNC players as well as budding entrepreneurs to assist during the process. Companies, government, and academic organizations are coming together and taking efforts to train, educate and provide skilled employees.
4. The Union cabinet of India introduced the Pradhan Mantri Krishi Sinchaee Yojana (PMKSY), and planned a donation of Rs 50,000 (US$ 7.5 billion) which is for a period of five years from 2015-16.
5. The initiatives are aimed to supply water to each village in Indian nation by covering varied irrigation plans for one centered irrigation plan. Government of India intents for paying Rs 75,600crore (US$ 11.34 billion) for produce Electric supply with the help of alternate feeders for farm and for domestic use for the Indian rural areas. This plan is focused toward increasing potency of supplying electric power and hence giving non-stop power offer for rural parts of India.

6. For increasing farm-based works the Government started 'A scheme for Promotion of Innovation, Rural business and Entrepreneurship (ASPIRE). Below this plan, a set of technology centers as well as incubation centers have been made to speed-up the entrepreneurship as well as to push start-ups with innovation and entrepreneurship in farm-industry.
7. The Government of India looks to push innovation and technological modification within most of the rural and tribal regions. The Government intends to make a group to review varied innovations for submitting the studies to the involved Department or Ministry. The scheme known as the 'Nav Kalpana Kosh' which targets the improvement of rural parts at varied levels, like governance, farming as well as health and hygiene.
8. Financial institutions are operating to line up rural ATMs, which can provide money in small amounts of notes.

B) Challenges in Rural Markets

1. **Low Literacy:** The proper education facilities are not available in these areas. The education level is very low 36% when it is compared to all-India literacy average of 52.
2. **Communication Problems:** Technologies such as telephone, fax and message are very less available in these areas. Rural areas are not able to take advantages of such things but, this case is very volatile thanks to the proper use of information technology.
3. **Traditional Life:** Life in rural areas continues to be ruled by old thinking's as well as traditions and other people don't simply accept sudden changes. As an example, the high class and literate category of farmers never use modern clothing's or branded footwear.
4. **Awareness:** There is very less awareness as well as knowledge of customers buying behavior in the Indian markets makes issues in preparing methods and selling strategies.
5. **Seasonal Demand:** Need of a product in the markets is based on the farming scenario, as farming is one of the important supplies of money. Sivanesan (2014) studied that farming mostly depends on the climatic conditions and, hence, the need or purchasing capability isn't regular.

6. **Transportation:** Several areas aren't well connected transportation systems such as by rail and road transport. Kacha roads are not useable in the rainy season as well as the interior villages get isolated.
7. **Distribution:** An efficient goods providing plans is needed for village-level merchant, Mandal/Taluka-level wholesaler or most popular dealer, distributor at the district level and the firm which owns selling at a higher level. Due to a lot of levels within the distribution system will increase the price of distribution.
8. **Vastly scattered market:** About 75th of the overall population is present in these parts of India. In some parts, 80-90% of the overall densities of people are living in the rural areas. "Demand isn't focused and scattered proving difficult for marketing communications".
9. **Buying Decisions:** Rural customers as always are very careful while deciding what to buy and this process is kind of slow and extended. They prefer to take some early use experience and solely after attaining the level of satisfaction these people will buy that product.
10. **Language Barrier:** There are a lot of languages which the rural villages have over different areas is one more issue the sellers have to face. It looks like an insurmountable downside in planning the contacting plan. More than 30 languages as well as 1700 dialects are the reason for rural communications being tough. Urban is basically ruled more by English and Hindi while the rural parts usually want communication systems available in their native language and idiom.
11. **Packaging:** Packets of small size are in high demand in rural areas. All products don't seem to be offered in small packing's. However, branding is not available in their native language, so rural individuals do not grasp the features of the goods sold.
12. **A career in Rural Market:** Whereas rural selling provides a difficult way ahead, a rural marketing person will need a good knowledge and ample amount of talent.
13. **Cultural Factors:** Culture is said to be a set of shared values, beliefs and perceptions which are said to have a change on buying patterns of customers. A lot of groups vary from one another and are on the basis on religion, caste, occupation, income, age, education and politics and every cluster has its own effect on the buying pattern of individuals in the rural. The rural people believe on experiences and consider it very necessary rather than proper education and when salespersons offers them practical solutions for the issues they tend to buy from him. That's why, it's fascinating when

sales people, particularly those that are referred in cities and are going through proper coaching which consists of all the theories and knowledge of the village life.

14. **Urban mind vs. rural mind:** There's an amazing distinction comparing the urban and rural outlook. It has an enormous difference within customer behavior in rural areas and urban areas. Most of the sales people are from cities and that's the way they think which is a problem to go parallel with the rural customers.
15. **Lack of planning:** A lot of sellers in the markets don't begin a business for just financial need; but also to run with no business aims, typically to fight job scarcity. Most of them are not looking at a profit but take it as simply in a different way of life.
16. **Warehousing drawback:** It causes trouble for the goods and price side of selling mechanism. Covering the specified level in the delivery of product looks terribly troublesome. The value of providing the goods becomes very expensive.
17. **No desire to adopt a new lifestyle:** Rural areas are very traditional and these customers are mostly carried away by culture, religion and belief. They have a tendency for following their traditional and old customs and therefore their life goes on a steady pace

C) Reasons for Companies to go Rural

Looking at the current situation, corporations operative in the country has solely 2 choices first one is to go global and second one is to go Rural. But planning to go international is incredibly expensive, as well as very tough to measure demands in different geographical areas. Rani and Shrivastav (2014) studied that focusing on the Indian rural market is a good option as it the market is increasing day by day.

Rural market is rising on a large scale for a variety of products and services such as monetary services, healthcare, education and telecommunication, etc. Following listed below are few explanations to why a lot of companies are so keen for entering the Indian rural market:

- **Saturated Urban Markets** – In the urban markets the competition is very cutthroat because of a good choice for selections of product. Therefore the existing corporations are facing very tough competition to keep up their market share in these markets.
- **Untapped Market Potential** – The number of villages reached are solely 100,000 of the 638,667 up to now. The market has a huge ability and market space. As the population of rural India is around 833.1 million which is a large market?

- **Remittances from Abroad** – Several households in India a lot of times have only person amongst the whole family situated in foreign country and mainly in Gulf regions. Individuals who work in these countries save some money and send it back to India to their family members an extra supply of income.

D) Key Decision Areas

Rural Market Segmentation: A seller requires some necessary ways of knowledge on the market and may contemplate many parts and for dividing the markets. It is not very urgent concerning what areas to settle on. The below areas look more interesting and related to the Indian rural market may be thought of in considering the various market parts:

- Geographic location
- Population density
- Gender and age
- Occupation
- Income levels
- Socio-cultural considerations
- Language and Education level
- Way of living etc.

Except that traditional strategies of separation, we are able to conjointly use few a lot of sub-parts which are below:

A) Size of Land holding
B) Water facilities
C) Farming way
D) Literacy level
E) Proximity to cities
F) Working classes (labourer, farmer, etc.)

❖ **Product Planning:** Corporations need to take into account of the pre-existing good product out there selling in the urban market may can be sold within the markets with none development. It's recommended for corporations 1st to see the need of customers in the rural areas then choose product which is present at the right moment. The subsequent stats should always be of modifying product for Indian markets:

- The goods should always be made in such a way that it should be easy to grasp, use, keep as well as reuse.
- Practical parts instead of elegant appearance are a good way of using.

- Value of the product is needed to be inside the buying ability of the customers.
- The look of packing is supposed to be straightforward, provide the details of how to use the product, shouldn't increase price and result in money use of the goods.
- Before selling the goods name is supposed to meet the understandings of the rural thinking's.

❖ **Pricing Decision:** Pricing methods are highly connected to packaging and positioning. The product packaging and looks provide a view to keep the costs less just to get in buying ability of rural customers but it is completely wrong to think that solely low cost goods or cheap product selling in rural areas. The choice of poor financial status customers is shop for one thing that justifies the price for the value, which is known as utility value.

Rural customers are able to purchase expensive product significantly once after the farming time as well as in festive period. The value and placement choices are so affected not simply because of financial gain returned however additionally on once it's got the way it's disbursed for totally separate wants of customers.

❖ **Distribution Strategies:** It's widely understood that the transportation infrastructure for a lot of parts in India have very shape. Although India is said to have one of the largest railway system within the world, several areas in rural India stay far from and are not connected to the railway system. About 50 percent of the 570,000 villages in India don't have good roadways. Whereas few changes are going down on behalf of varied road construction schemes, several parts face dangerous roads and many internal parts of the villages barely see proper roads to talk about. As regarded transport facilities, the foremost basic vehicles are mainly the delivery vans and also carts. As a result of the problem in access, delivery of product and goods is still very tough in these areas.

❖ **Promotion:** Rural areas have several small meals and festive periods and retailer take advantage of these things to promote their product. The conjoint use of the delivery van promotion in areas wherever these vehicles. Salesperson who has vans goes from one village to other. Vans are connected with projectors or music players to attract the eye of individuals and then promote their brand. The salesperson will use this opportunity to promote his brand and on-spot marketing. Where potential on the idea of those sales a neighborhood seller is also driven to store the goods. These sellers always give demos of their products show as well as selling in these fairs and festivals.

❖ **Communication and personal Selling:** Rural consumers do not have a lot of education, the scope for exploitation printed magazines, newspapers, periodicals etc. isn't a good

idea. This problem is also connected by the language barrier. Within the urban parts most of the things are done in two widely used languages which are English and Hindi. Communication within the Indian rural area must necessarily take place in the local language.

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Dimensions of Livelihood in Rural India

CHAPTER - 08

The Digital Literacy Dream : Upskilling India for the Future
(A Conceptual Framework)

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8.1 Introduction

While the Covid-19 pandemic has accelerated the pace at which technology is becoming commonplace in our lives, it has also exposed a stark digital divide, leaving a large proportion of India's population out of this paradigm shift. Workplaces rapidly shifting to digitally enabled business solutions, education and medical consultations going online, and contactless digital transactions being preferred and promoted are just a few examples of how technology is quickly establishing a ubiquitous presence. However, the pandemic has also exposed a stark digital divide, leaving a large proportion of India's population out of this paradigm shift. The ever-growing ubiquity of technology has made digital literacy the new currency of the 21st century. The ability to navigate the tectonic shift from physical to virtual interactions has assumed great significance, given that the pandemic has induced an unprecedented wave of hyper digitalization and tech-dependence. Across the globe, the pandemic has exposed the harsh realities of the digital divide, and nowhere is this more evident than in India, where the abrupt push into cyberspace has worsened the plight of its digitally illiterate population.

To begin with, education has been disrupted, with the closure of 1.5 million schools having affected as many as 247 million children. The lack of technological fluency among students, parents, and teachers has impeded the transition to remote education. According to estimates, only one-third of schoolchildren in India have been able to pursue online learning. Ironically, while digital illiteracy has hindered the dissemination of education, it has given an impetus to the spread of misinformation. The deficit of digital skills has resulted in significant chunks of the citizenry being unable to assess the credibility of the content they encounter online, making them vulnerable to the deluge of fake news, unverified claims, false cures, conspiracy theories, and political propaganda related to COVID-19 on the Internet.

Meanwhile, the meteoric growth of e-commerce during the pandemic has severely impacted countries facing a shortfall in digital aptitude. In most developing countries, including India, many consumers and businesses do not possess the technical skills needed to leverage online opportunities for buying and selling. Furthermore, with the integration of digital financial services in the existing banking system, the challenge of financial inclusion has come to the forefront.

Although these e-services have ushered in a slew of crucial benefits, including faster, safer, and easier transactions, access to them is difficult for users with low digital proficiency. The existing state of affairs, although unsettling, is not surprising. As yet, India has fared poorly in bridging its gaping digital divide. This is evidenced by the deplorable condition of digital literacy in the country. The latest government data on household social consumption relating to education indicates that only 17% of the population (aged 5 and above) can operate a computer and just 20% have the ability to use the Internet.

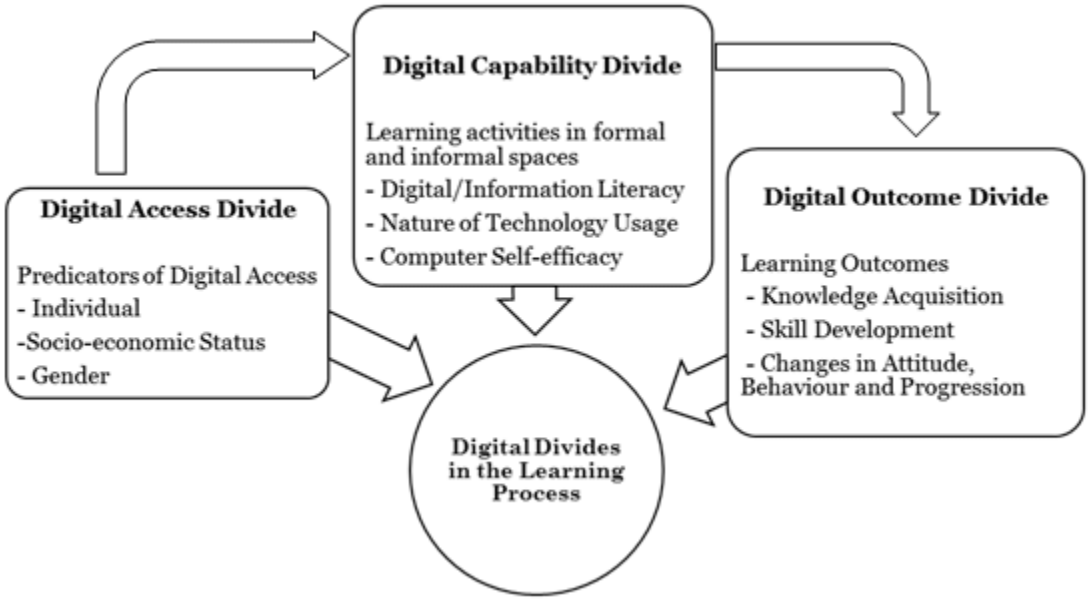

Figure 8.1 : Digital divide and learning Process

8.2 Digital Literacy Schemes

National Digital Literacy Mission (NDLM) has been initiated with the vision to empower at least one person per household with crucial digital literacy skills by 2020. This is expected to touch the lives of more than 250 million individuals over the next few years. NDLM is an effort to complement government's vision to transform one from each household as digitally

literate. The project aims at helping adults with low technological literacy develop the skills they need to interact in an increasingly digital world. To a great extent, it is the glaring inefficiency of the government that lies at the root of the problem. Under its flagship "Digital India" programme, which aims to transform the country into a digitally empowered society, the government has, to date, operationalised three digital literacy schemes.

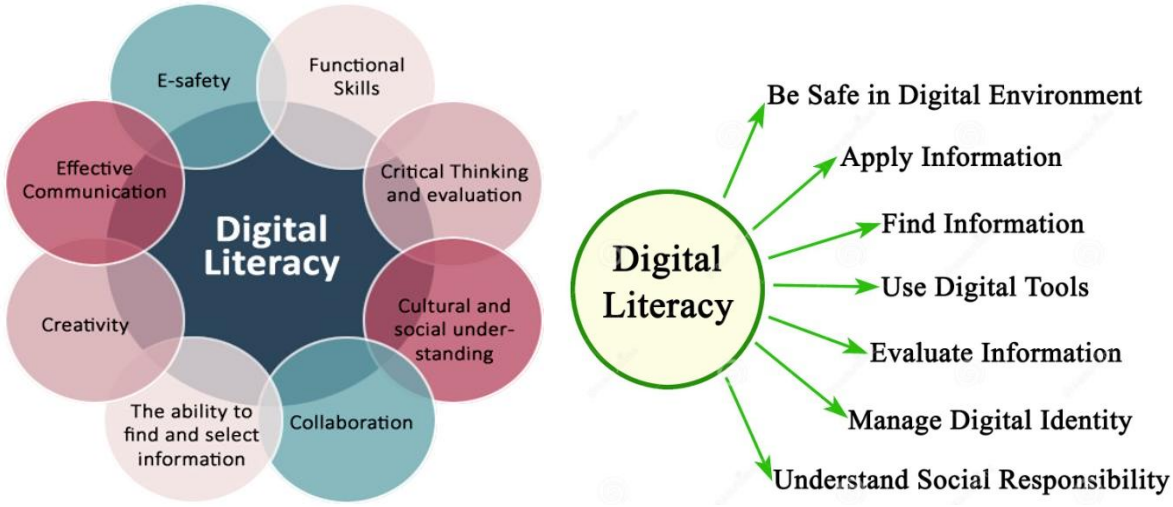

Figure : 8.2 (a) and (b) Digital literacy schemes and related factors

In 2014, the National Digital Literacy Mission (NDLM) and the Digital Saksharta Abhiyan (DISHA) were launched concurrently to impart digital training to about 5 million citizens, and within two years, both achieved their stipulated targets. The pattern of education has changed overnight, and digital learning has emerged as the primary alternative. This sudden switch and overdependence on technology has come with its fair share of constraints. Amidst this transition, for the first time in 34 years, the erstwhile Ministry of Human Resources and Development, now known as the Ministry of Education, launched the New Education Policy on 29th July 2020.

Expectedly, the policy proposes several measures for promoting digital learning and enhancing infrastructure requirements. However, given the socio-economic and regional diversity of India, there exist multiple roadblocks to accessibility and the ability of widespread adoption of online teaching and learning, some of which are discussed in this commentary. The key problem surrounding remote learning and online classes in the country is the issue of equitable access. Along with adequate penetration of internet and technology services, accessibility in this context also includes access to electronic devices such as computers and smartphones.

8.3 Digital Literacy and Data Penetration

According to NSSO data, only 4.4% of rural households and 23.4% of urban households own computers. Moreover, while 42% of urban households have a computer with an internet connection, the same is available to only 14.9% of rural households. A report by Nielson in 2019 concluded that 70% of the rural population does not have an active internet facility with states like West Bengal, Bihar, Jharkhand and Odisha having the lowest internet penetration. Especially in the northeastern states, the findings of the report indicate that users are less affluent and predominantly male.

Remote learning has also been a challenge for students in the union territory of Jammu and Kashmir. The ongoing ban on 4G internet has been particularly challenging for students and teachers in the state with digital learning becoming the only option during the pandemic. It has been reported that the available 2G internet connectivity has led to unclear audio and frequent video call drops, among other problems. There are approximately 500 million smartphone users in India as per a recent report by the Indian Cellular and Electronics Association (ICEA), which could reach 829 million by 2022. Increasing affordability of smartphones, growth in number of users in rural India, as well several government initiatives have led to the expansion of India's smartphone user base in recent years. However, on the other side of this growth is the fact that there are still around 800 million people that do not have access to smartphones. The audio-visual content in online learning, whether in the form of video calls or downloadable/streamable videos, requires high-speed 4G internet.

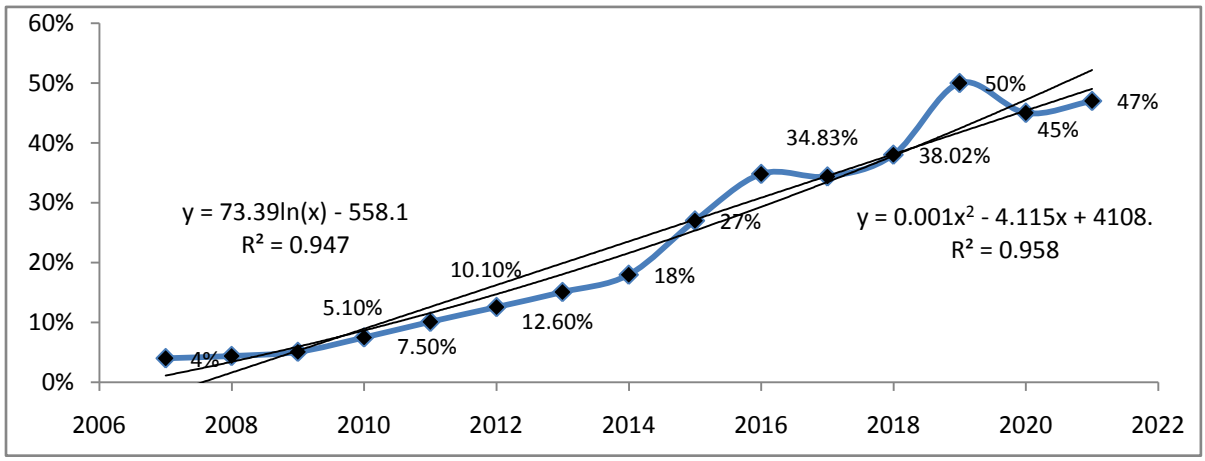

Figure 8.3 : Internet penetration rate in India

As per the ICEA report quoted above, in 2018, India had approximately 277 million VoLTE capable devices and more than 50% 4G device penetrations across India. However, the share

of smartphone penetration was only around 25% in rural areas. Given that 99% of rural internet users access the internet on mobile phones; this effectively means that a majority of students in rural areas do not have the tools required to access online classes. Some of the worst consequences of the lack of smartphone penetration and 4G internet have been incidences of student suicides, seemingly in response to the inability to afford smart devices and the mounting pressure to attend online classes to keep up with coursework.

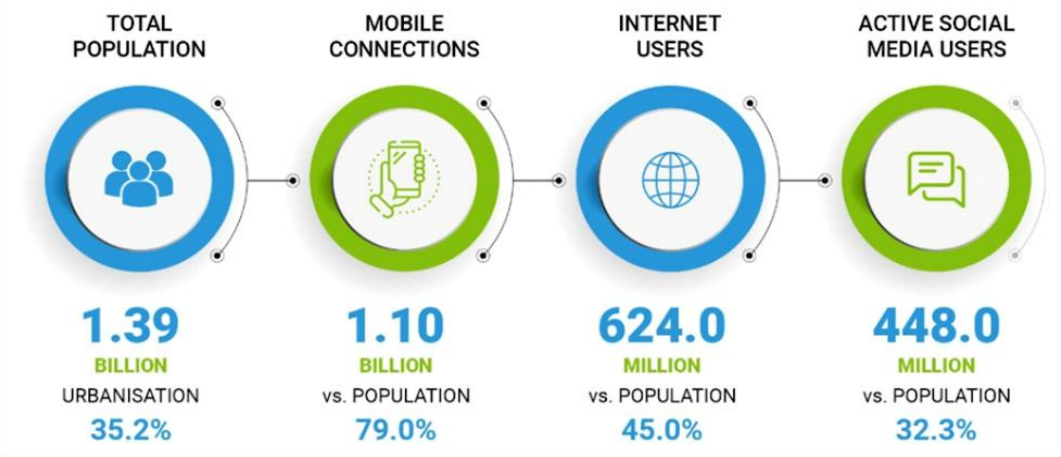

Figure 8.4 : User acquisition in India - 2021

According to UNICEF, the closure of schools in 2020 has affected more than 1.5 billion children and young people worldwide, leading to a wide range of psychological and behavioural challenges. The increase in screen time not only impacts children physically but can also lead to heightened risk of online exploitation. The rise in the use of virtual platforms may expose young children to harmful virtual content which may also contribute to cyberbullying. An online survey conducted by me among 450 students across 05 faculties in my university MGCGV Chitrakoot, Satna [MP] showed that students often complained about frequent headaches and neck/back pains due to long online classes. The survey indicates that students are subjected to average 4.5 hours of screen time in a day, which includes both departmental lessons as well as social media applications.

8.3.1 Online Learning and Performance Indicators

Online learning has further proven to be a considerable challenge for students with disabilities. As per a phone-based survey of 600 students with disabilities conducted by the students of FET, MGCGV Chitrakoot, Satna [MP] in January 2021, 58.5% were found to be continuing their studies with the rest opting to drop out. Additionally, only 54.2% of those interviewed had access to personal or collectively used smartphones. The survey also found

that deaf students, specifically, were struggling during webinars with multiple speakers and generally finding it difficult to lip-read on screens. Notably, teachers are also at a high risk of being impacted both physically and mentally because of increase in online learning.

Many media reports indicate that virtual classrooms have made significant adverse impacts, particularly, on female teachers. Remote learning has led to an increase in bullying of female teachers by older students and has thrown up numerous incidents of violation of privacy of teachers. As per the Indian Telecom Services Performance Indicators for July-September 2020, on 30 September 2020, the total number of internet subscribers per 100 people in India stands at 57.29, with this number being around 3 times higher for urban India (101.74) compared to rural India (33.99). As per the report of the 75th round (2017-2018) of the National Sample Survey (NSS), household-level statistics reveal that only 4.4% of rural households own a computer as compared to 23.4% for urban households.

Table 8.1 : Gram Panchayats equipped with internet access across India as of August 2020

Name of State	Gram Panchayats equipped with internet	Name of State	Gram Panchayats equipped with internet
Uttar Pradesh	29225	Uttarakhand	1530
Maharastra	17097	Kerala	1129
Madhya Pradesh	13225	Tripura	559
Punjab	12789	Jammu & Kashmir	382
Gujrat	11888	Manipur	326
Rajasthan	8807	Himanchal Pradesh	252
Bihar	8608	Nagaland	127
Karnataka	6247	Meghalaya	122
Haryana	6193	Puducherry	101
Chhattisgarh	5047	Arunanchal Pradesh	88
Odisa	4328	Mizoram	41
Jharkhand	2675	Sikkim	28
West Bengal	2373	Dadar & Nagar Haveli	21
Telangana	2047	Daman & Diu	18
Andhra Pradesh	1660	Chandigarh	13
Assam	1624	ANI	8

Table 8.2 : Allocation to the Department of Telecommunications (2020-21)

	2018-19 Actuals	2019-20 RE	2020-21 BE	% change (RE 2019-20 to BE 2020-21)
Revenue	18,492	18,435	40,757	121%
Capital	2,114	4,915	25,675	422%
Total	**20,606**	**23,350**	**66,432**	**184%**

Note: RE: Revised Estimates, BE: Budget Estimates (in Rs crore)
Sources: Department of Telecom, 2020-21

In terms of access to the internet, 42% of urban households have access to the internet while the corresponding figure for rural households is only 14.9%. While availability of digital infrastructure will play a crucial role in bridging the existing gaps, it is equally important to build digital skills among the Indian population to be able to take advantage of this infrastructure. We use household data from the 75th Round of the NSS to understand digital literacy in India, and make recommendations for a way forward in the context of several initiatives taken by the government. In India, across over 6,50,000 villages and 2,50,000 Panchayats represented by 3 million Panchayat members. Approx 40% population is living below poverty line, illiteracy rate is more than 25-30% and digital literacy is almost no-existent among more than 90% of India's population. Most are remote and too isolated to benefit from the country's impressive economic progress.

8.3.2 Young Force Boosts Employment

Today's youth are the trend-setters, makers, builders, and leaders of tomorrow. In any country, they are the most important and dynamic segment of the population. Nations with a large youth population are thought to benefit greatly from investing in young people's education and health, as well as protecting and ensuring their rights. However, they require the necessary support in the form of good health, opportunities, and skills to transform the future. When there are more hands available to work than mouths to feed in a country, an economic trigger occurs. India has a great opportunity to supply a workforce to its industries and the rest of the world. This is likely to attract foreign companies to set up industries in the country. The labor is affordable and the people are willing to work for longer hours than their counterparts in developed nations. The return of investment for a foreign company is much greater than it would be in other countries. Apart from this, the rapid adoption of digital technologies can pave the way for more job opportunities for the youth of the country, for which skill development is the key. As we continue to exchange thoughts on

bouncing back, the business world will need to nurture the digital skill sets of its workforce and make efforts to enhance their cognitive, social, and emotional skills to make them agile and resilient to handle any unpredictable situation.

8.4 Upskilling and Knowledge Proficiency

Upskilling initiatives have the potential to create 5.3 million new jobs globally by 2030. We have all seen micro and small businesses taking a digital leap amidst the pandemic to deliver service excellence to customers. From pharmacies to groceries to healthcare, entertainment, and education people across industries embraced digital to match steps with the changing times. Right skilling is crucial in identifying gaps in the existing system.

Upskilling is assisting youth in increasing their productivity. It means to keep them in sync with the constantly changing world of work, transferring theoretical knowledge proficiency to real-world applications which are helping them in getting jobs in start-ups and various other established companies that are searching for young enthusiasts who can stay on top of new business best practices and ensure that the company is competitive. This is beneficial as it makes the youth productive, scientific-oriented, and broad-minded. This further helps them contribute to the success of the company. It makes them adaptable and encourages them to accommodate and tune to change. Further, it benefits them to set realistic goals. The unemployment situation can be tackled by providing skill development training at a much faster rate than is happening in the last few years.

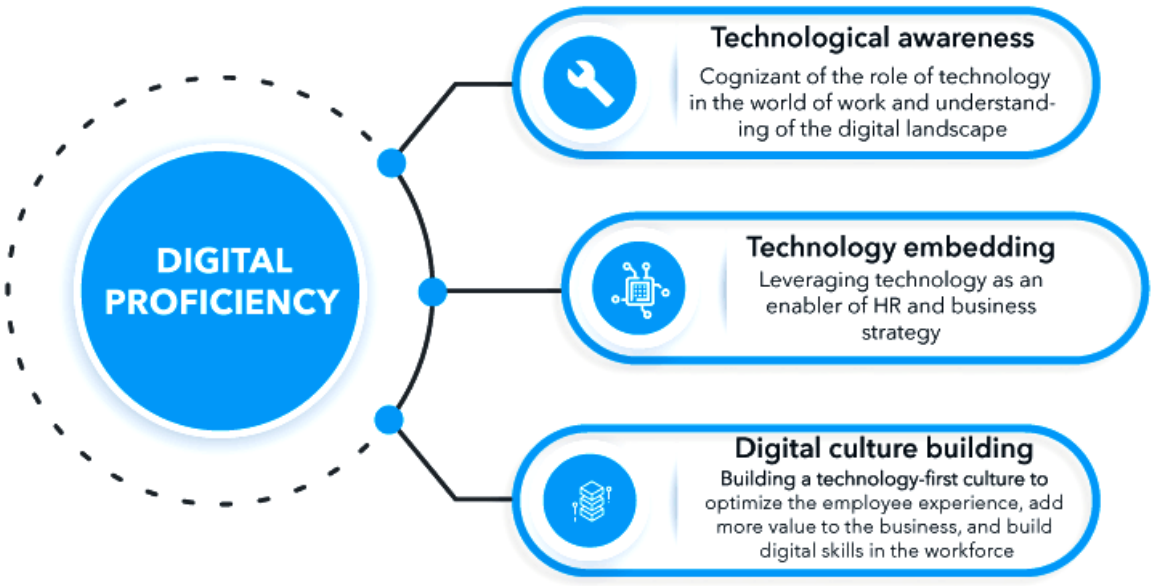

Figure 8.5 : Digital proficiency factors (Source : aihr.com)

Presently, only 2 per cent of the total workforce in India has undergone skill training. Three-fourths of the youth in the country have never enrolled on a skill development programme. While government interventions and private companies are working to provide skill training, more interventions are needed to see a sizable impact. Many non-profit organizations in India are working towards empowering the underprivileged through skilling. Through their initiative they offer three types of programs

- **Youth Job Readiness Program**

This prepares final year college students for the job market. They mentor and train youth with life skills or offer entrepreneurship training to make them future job-creators. In modern organizations, almost every new product is powered by the internet. And almost everything on the internet is built by product and engineering teams. In order for an employer or organization to have complete autonomy over its projects and to establish a clear vision for the future, it is imperative that everyone in the organization understand how the business operates. In the short term, it is imperative to offer up-skilling to all employees and organizations would be encourage to begin by teaching basic computer science and coding. While this might seem extreme, the goal is to better equip employees to communicate and even collaborate with engineers, who are paving the way forward. All corporate employees must be well-versed, if not fluent, in social media and how to tell their story across various channels.

- **Computer and Digital Literacy Program**

This provides basic computer and digital literacy training for girls and women who have either dropped out from school or are currently pursuing their education. The onsite training program opens up avenues for housewives and married women who want to get hands-on training in the digital literacy space.

- **Banking and Financial Skill Development Program (BFSI)**

This aims to open avenues for the aspiring youth of our country who are keen on making their career in the banking and finance sector. The program focuses on equipping 12th pass students, final year undergraduates and graduates with the BFSI skills and relevant job-readiness skills.

8.5 Digital literacy levels in India

The Ministry of Electronics and Information Technology defines digital literacy as “the ability of individuals and communities to understand and use digital technologies for meaningful

actions within life situations. Any individual who can operate computer, smartphone and use other IT related tools is being considered as digitally literate." Based on this definition, we define households as being digitally literate if at least one person in the household has the ability to operate a computer and use the internet (among individuals who are 5 years of age and older). Based on the above definition, we find that only 38% of households in India are digitally literate. In urban areas, digital literacy is relatively higher at 61% relative to just 25% in rural areas. Entry-level digital skills can include:

- Computer literacy
- Data entry
- Social media
- Web-based communications and research
- Word processing
- Email and chat
- Secure information processing

Advanced digital skills can include:

- Programming, web, and app development
- Digital business analysis
- Digital marketing and content creation
- Digital design and data visualization
- Digital product management
- Data science
- User experience design

8.6 Digital Adoption and Digital Technologies

Digital adoption and the respective digital skills needed to embrace the transformation are critical to landing more secure, in-demand tech careers. In fact, those skills are essential to the survival of businesses. Digital skills have never been more critical to business and the workforce, as demonstrated by the universal shift to digital-first interactions like remote work, online commerce, and virtual collaboration. This change has produced many benefits, like greater flexibility for workers and removing geography as a barrier to hiring new talent. The economic implications of the digital skills gap are massive. The democratization of digital skills will not reach every country, industry, and community equally. Until people from underserved and underrepresented backgrounds get equal access to technology and

education for re-skilling, the skills gap will continue to grow. Success, prosperity, and equality in the new digital-first world depend on everyone having the skills to participate.

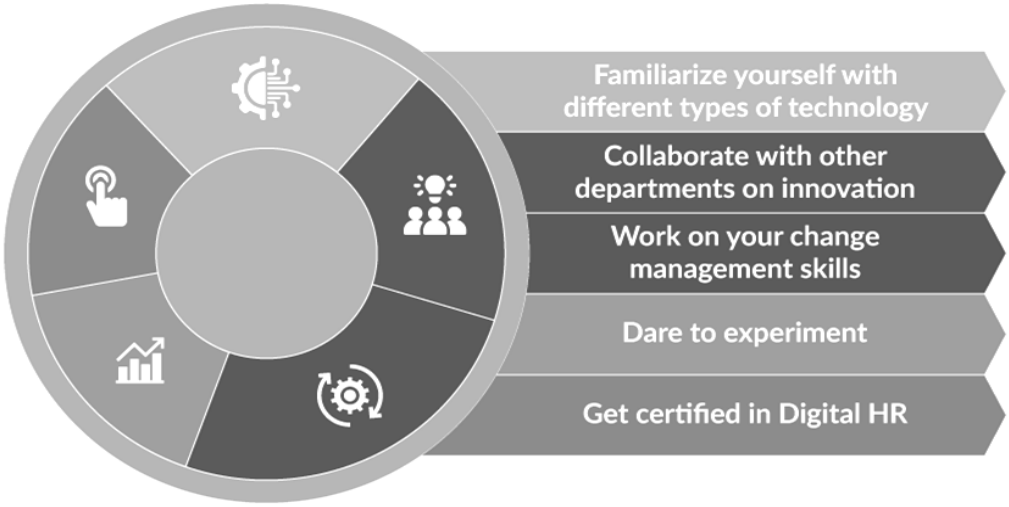

Figure 8.6 : Digital proficiency and adaption actions (Source : aihr.com)

The rapid adoption of digital technologies can pave way for more job opportunities for the youth of the country, for which skill development is the key. As we continue to exchange thoughts on bouncing back, the business world will need to nurture the digital skill sets of its workforce and make efforts to enhance their cognitive, social, and emotional skills to make them agile and resilient to handle any unpredictable situation.

❖ Reskilling and upskilling Concepts

The World Economic Forum projects that by 2022 at least 54 percent of all employees will need re-skilling and upskilling to respond to the changing work requirements. This explains why upskilling and re-skilling strategies will be core in bringing about more long-term changes in future workplaces in post-Covid world. There may be a 'three-pronged' approach for the youth of our country to continue to stay relevant by igniting their minds with proper skilling.

❖ Bias for Action'

One of the greatest qualities required to make a positive difference in the world is the 'bias for action'. It simply means having a tendency to favour action over inaction. The essence lies in thinking innovatively, recognizing the need of the hour, reading the pulse of the market and executing the game plan as fast as possible to drive better results and growth. Embarking on the skilling journey early on in life helps in becoming thoughtful of our

realities, in developing solutions that are apt for the situation, and in fostering an innovation ecosystem. It has been reported that upskilling initiatives have the potential to create 5.3 million new jobs globally by 2030. We have all seen micro and small businesses taking a digital leap amidst the pandemic to deliver service excellence to customers. From pharmacies to groceries to healthcare, entertainment, and education people across industries embraced digital to match steps with the changing times. Right skilling is thus crucial in deciphering gaps in the existing system, challenging the status quo and designing disruptive solutions.

❖ Never-ending hunger to 'Learn, Unlearn and Re-learn'

Be it our personal or professional lives, today everything is driven by technology, which is why familiarity with technology should be built purposefully. To keep pace with the dynamically changing world, we should not only learn continuously but also be ready to unlearn some aspects and also re-learn the new way. For instance, a few years back, the concept of interactive learning videos for kids may not have been quite acceptable. However, today we have learned to unlearn some of the old methods of learning and have understood that interactive videos and bite-sized learning modules can in some ways make the learning process much more engaging and easier. Similarly, a few years back, physical and face-to-face business meetings were the only mode preferred, but today, being in an organization means that we have to be flexible in terms of unlearning and learning the new ways of connecting virtually over digital means. Reverse mentoring by millennials is an excellent way to learn, unlearn and re-learn and this will, in turn, nurture the bonds between employees irrespective of age. We should invest a considerable amount of time in connecting and learning from the young generation both at the workplace and outside the workplace. This helps us to view and approach situations from different perspectives.

❖ Be a Master of Multiple Disciplines

Put on the different caps and we will be amazed to see what we can accomplish. In today's hyper-connected, digital world, becoming a 'master of all trades' or 'knowing all the trades' is very important. Diversity of knowledge and ideas is good for shaping our future generation. Someone could be interested in becoming an entrepreneur and a teacher and a scientist—young minds should be allowed to train in a variety of skills to nurture their interests and pursue them. We must focus on nurturing soft skills such as communication, creative problem-solving and entrepreneurial abilities to build an agile and resilient mindset. There is also the need for greater integration of higher education with vocational training. As technology is rapidly evolving, organizations are looking for full-stack professionals who can

understand and implement solutions end-to-end, which require gaining mastery in multiple disciplines within an organization. Survival in a new normal world depends largely on collaboration and co-creation. Therefore, collaboration between all the stakeholders is important, including employers, government, and working professionals.

8.7 Upskilling India through PMGDISHA

Recognising the urgency to upskill rural India and to bridge the digital divide across rural and urban India, the Government of India launched the PMGDISHA scheme in 2017. This is the world's largest digital literacy programme with a target of making 60 million people in rural areas digitally literate, involving 40% of rural households with one member per household being trained under the programme. The objective of the scheme is to provide 20 hours of basic training on digital devices and the internet, and how to use these tools to avail government-enabled e-services with a special focus on cashless transactions. Till date, approximately 2.76 crore candidates have been certified as digitally literate under Pradhan Mantri Gramin Digital Saksharta Abhiyan (PMGDISHA).

While the PMGDISHA scheme is beneficial for introducing more people to the digital world, the connection with technology would be more long-lasting if the scheme expands its objective to enhance livelihood of beneficiaries through usage of technology. This can be achieved by launching targeted interventions for various beneficiary groups. For example, farmers in India incur huge losses due to unavailability of accurate and timely information regarding weather trends, sustainable farming techniques, and markets.

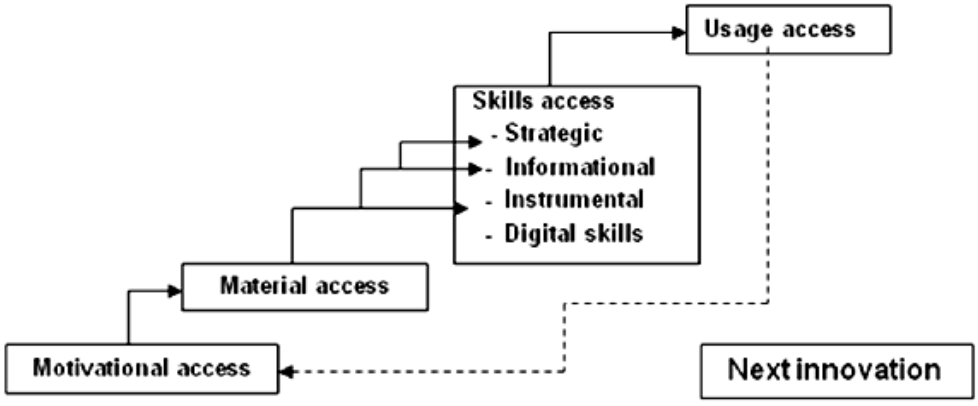

Figure 8.7 : Upskilling digital innovation process

Access to and use of digital tools would help farmers make more informed choices in terms of agricultural practices. This would also be an important step towards mainstreaming

'digital agriculture'. Along these lines, the Confederation of Indian Industry (CII) along with Rajiv Gandhi Institute of Veterinary Education and Research (RIVER) Puducherry launched a Farmers' Digital Literacy Centre in early 2020 to enhance digital literacy among farmers and spread awareness about sustainable farming techniques. Setting up such centres across the country or utilising existing infrastructure like Common Service Centres (CSCs), school IT labs, Krishi Vigyan Kendras (KVKs) etc., to train farmers in the use of digital technology, is a crucial step towards upskilling the agricultural workforce.

Table 8.3 : State/UT-wise targets for digital literacy (May, 2018) – Under PMGDISHA Scheme

States/UTs	Target	States/UTs	Target
Uttar Pradesh	11171000	Haryana	1191000
Bihar	6630000	Jammu & Kashmir	658000
West Bengal	4481000	Uttarakhand	506000
Maharashtra	4433000	Himachal Pradesh	444000
Madhya Pradesh	3784000	Tripura	195000
Rajasthan	3712000	Meghalaya	171000
Karnataka	2705000	Manipur	137000
Tamil Nadu	2679000	Nagaland	101000
Orissa	2517000	Arunachal Pradesh	77000
Gujarat	2497000	Goa	40000
Andhra Pradesh	2028000	Mizoram	38000
Telangana	2028000	Sikkim	33000
Assam	1929000	Puducherry	28000
Jharkhand	1803000	Andaman & Nicobar Islands	18000
Chhattisgarh	1412000	Dadra & Nagar Haveli	13000
Kerala	1257000	Daman & Diu	4000
Punjab	1247000	Lakshadweep	1000

Another important aspect is user-centricity products must be designed considering the capabilities and needs of the end user. For example, if a mobile phone application is being developed to help in the dissemination of information to farmers, it must be taken into

consideration that a large number of farmers in India are still not literate. Considering this, innovative ways of communicating instructions through images, audio, and video can be adopted instead of text. Appropriately designed tools must be an integral part of the development of such digital products. The government should revamp existing portals and applications such as e-NAM (National Agriculture Market), to increase their acceptance and usage by a wider set of beneficiaries.

Lastly, the current targets of PMGDISHA are set uniformly across the country without taking into account differences in the baseline digital literacy levels. Goa, Kerala, Chandigarh, and Lakshadweep already have digital literacy levels exceeding 70%, while PMGDISHA target is to make 30% of households from each state/UT digitally literate. On other hand, many Northeast and BIMARU (Bihar, Madhya Pradesh, Rajasthan, and Uttar Pradesh) states have digital literacy below 30%. There is an urgent need for revisions in target-setting based on available data.

The current state of digital literacy in India clearly indicates that to achieve the goal of 'leaving no one behind' in the digital world, it is not only crucial to ensure better connectivity through the development of telecom infrastructure but it is also equally important to build skillsets amongst the Indian population to be able to make the best use of this infrastructure. The responsibility of fulfilling the dreams of a resilient and Atmanirbhar Bharat (Self-Reliant India) lies greatly on the shoulders of our youth. With their disruptive thinking, digital skills, human competency, and the quest for excellence, the future change makers are going to be force multipliers for economies worldwide.

8.8 Developing Digital Skills for the Future

Decades ago, email was a new concept, but it's become second nature for billions of people. Now more recent technologies like blockchain, AI and cloud have gone from niche, specialized roles to the mainstream, increasing business requirements for digital skills. Micro-degrees, or super-focused online degrees in a specific area of study, can help bridge that divide. In addition, those micro-degrees also can help propel people within industries where they already work or open a door for people looking for a career change. Digital Literacy means having the skills we need to live, learn, and work in a society where communication and access to information is increasingly through digital technologies like internet platforms, social media, and mobile devices.

In today's digital world, nearly every career requires digital communication at some point. The current COVID-19 outbreak has made the need for digital literacy and digital connections

more apparent. With uncertainty and unease across the globe and millions working from home, there's an increasing spotlight and pressure on technology to keep countries worldwide. During these difficult times, educational institutions showed how to efficiently utilize their time by holding online classes on various meeting apps (Zoom, Microsoft teams, Cisco WebEx). This was made possible by the digital literacy of teachers and students alike. We have almost 40% of the population below the poverty line, the general illiteracy rate itself is 25 to 30%, and digital illiteracy is more than 90%. The digital divide in India is another significant road-blocks on the path of digital literacy.

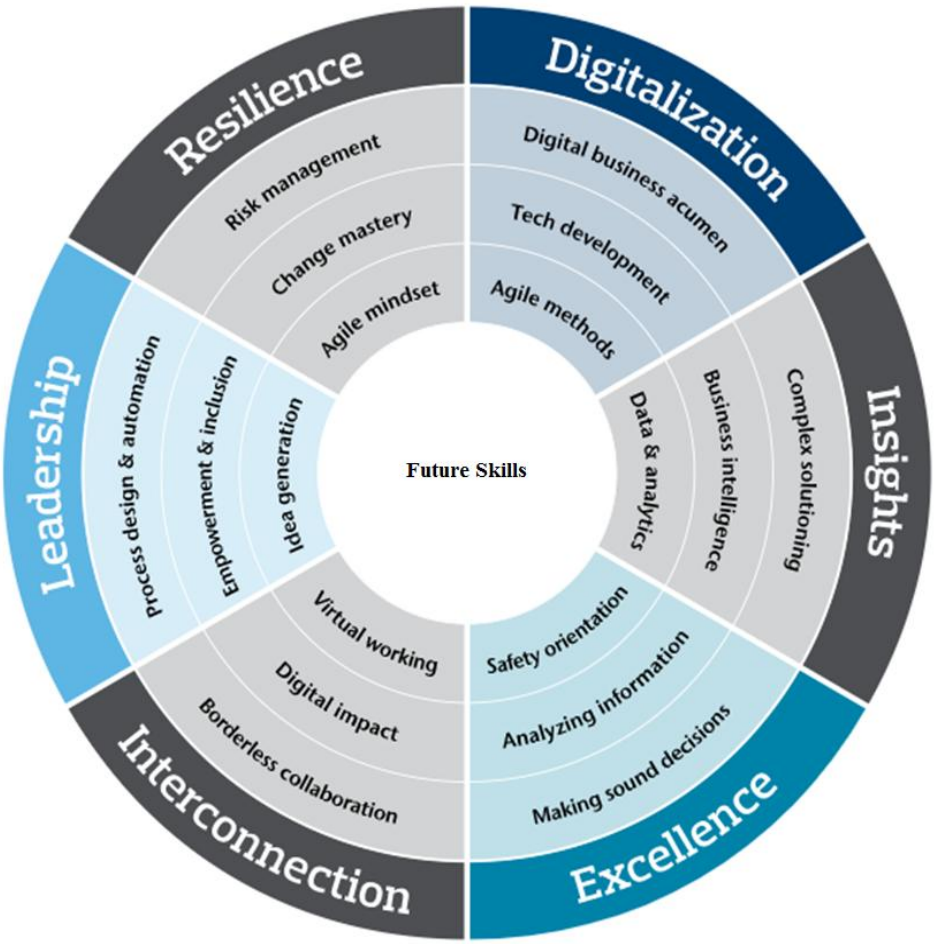

Figure 8.7 : Developing digital skills for the future and associated factors

Only 20.1% of people in all of India can use internet facilities. The presence of high-speed internet is limited to towns and cities, while many villages struggle to get a stable signal on their mobile phones. Also, the availability of broadband is almost negligible in rural areas. As

for online education, not only many of the teachers are digitally incompetent, but a large number of them also have never used an online environment to teach.

One of the key Digital India schemes 'Pradhan Mantri Gramin Digital Saksharta Abhiyan' approved in February 2017 to make one person each in six crores rural households' digital literate by March 2019. However, as on 31 December 2019, only 3.19 crore people have enrolled and out of which training has been imparted to only 2.56 crore. Of this, only 1.88 crores have been certified under the scheme. Even though TATA, JIO, and FACEBOOK rolled out several initiatives and projects for women and for low to bridge the gender and digital divide, but it's still a long way to go. But sheer will and focused minds can overcome all odds; let's try this time, not as an individual but putting our Nation first. If we all can have the same dream of ***"DIGITAL INDIA"*** we can indeed achieve elevated Digital literacy standards. Making the masses aware of the broad spectrum of functionality that they can have, with digital power in hand, will surely make them crave accessibility. Our government needs to emphasize proper implementation and regulate deadlines of current existing policies and upcoming new policies in our favor. To state a few

1. Emergence to increase the coverage of target from every day 6 crore citizens, along with incentivizing to digital literacy training;
2. Subsidizing telecom operators to provide internet services to segments of the population below the poverty line as well as for people living in remote areas;
3. Better investments in infrastructure and broadband connectivity at the level of villages
4. Strengthening data access, sharing, protection, privacy laws (digital security is a primary concern of most people);
5. Establish an internationally recognized digital skill standard-setting body to balance and supply of digital skills.
6. Next, comes our state governments, local governing bodies who safeguard these policies, have to modify a bit to develop better-integrated projects making them circle rural areas more.
7. Conduction of free webinars at district levels for people related to different sections, for example - business people employing around 20 or more employee, firm managers, leaders of various small non-government people organizations running in a rural household, to seed the very idea of importance to elevate digital literacy and how it can help their sectors; Another webinar for school teachers focusing first to make them digitally competent and then help develop alternative programs such as MOOCs (Massive Open Online Courses) eventually;

8. To develop some schemes, incentives to be awarded to those people who follow the above guidelines.
9. To set up a regulatory body among the above people to re-evaluate progress being achieved at every step.

We must not lose hope and we should help our brethren as we all are part of this great Nation. A smart blend of online and offline teaching can help in bridging the digital divide. With the growing use of smartphones by all categories of people can also help serve as a tool to provide digital literacy. Moreover, modern-day youth is aware that digital literacy places them in a better position to earn a job.

8.9 Opportunities for growth in India

India is a country where a majority of its population is online, with approximately 560 million users, yet the most recent National Family Health Survey found that over 60 percent of women in 12 states and Union territories have never used the internet. And that's despite 48 to 90 percent of women owning a mobile phone, which reinforces the idea that access to technology doesn't equate the ability to use it. That inequality for Indian women extends to the white-collar workforce, too. According to the United Nations Development Program's Human Development Indicators, just 26.9 percent of women enrolled in university are focused on science, technology, engineering, and math programs, and only 20 percent of women participate in the organized labor force while 76 percent are informally employed in roles that are manual, low-paying, and offer little to no benefits or opportunities for growth.

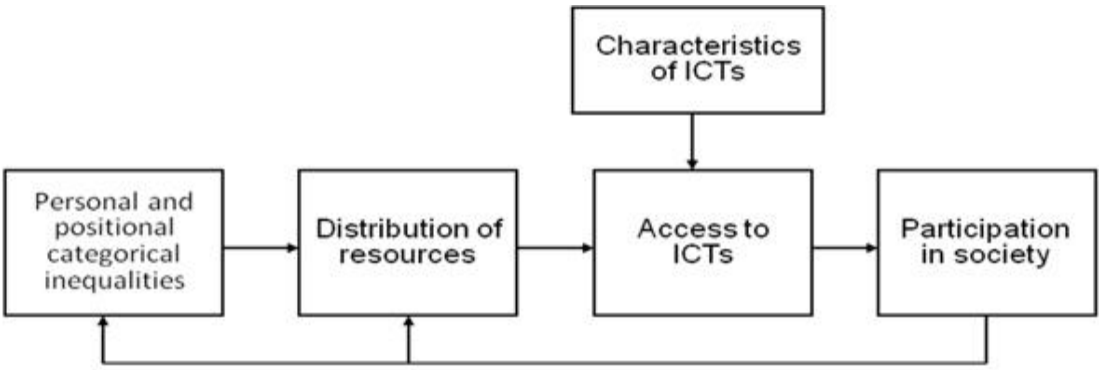

Figure 8.8 : Model of successive kinds of access to digital technologies

[Source: van Dijk (2005, p. 22)]

Digital transformation is on the rise and affecting every industry imaginable. Farmers are no longer merely sowing seeds and harvesting a crop; they're using sensors and information technology to automate, monitor, and regulate their systems to become more profitable,

efficient, and sustainable. Food delivery apps are helping restaurants provide their menu options to hungry patrons without them having to leave their homes. This adds a complex layer of responsibilities for restaurant workers who now must manage orders through digital devices, as well as any in-person interactions. Even real estate, a traditionally face-to-face industry, relies on digital skills. Virtual walk-throughs are available to prospects looking to relocate, and signing documents remotely with services

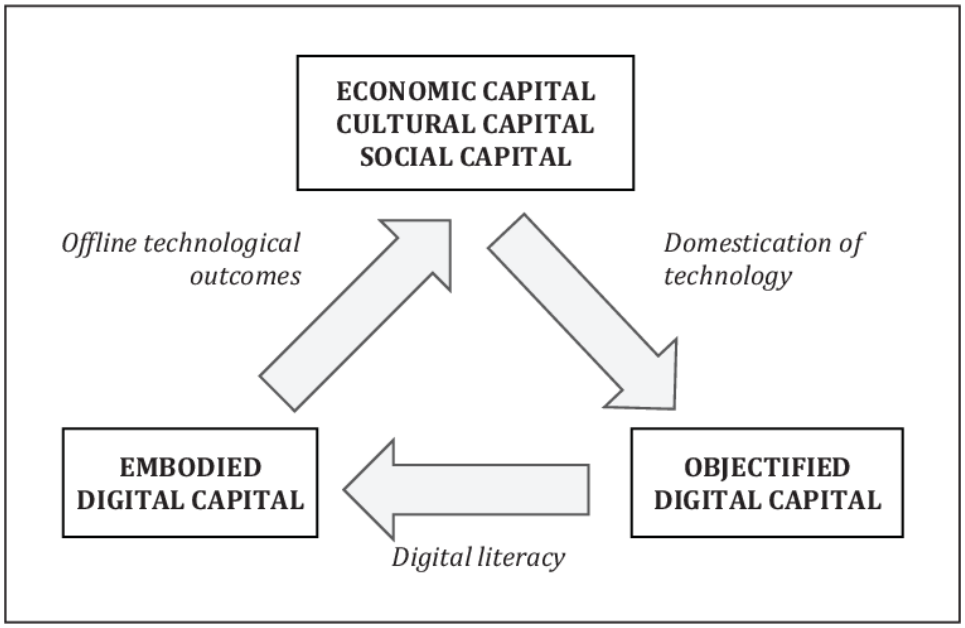

Figure 8.9 : Developing relation among digital, economical & cultural capital for upskilling

Without a firm command of digital skills, there is no way to propel innovation and remain competitive. Employers realize this, so they're prioritizing candidates who can showcase their digital literacy. By developing better digital skills, employees have a chance to contribute to their communities, future-proof their careers, and explore a wide range of professional opportunities. Approx 54% of all employees will need significant reskilling by 2022, specifically for technical skills like programming and App development. Over the next five years, the global workforce can absorb around 149 million technology-oriented jobs. When we stand out in the modern workplace, we improve our chances of excelling in our career. Whichever career path we choose, keep in mind that there are always new skills to learn and new technologies to master. For entry-level positions, the bare minimum digital skills required include the ability to carry out tasks, such as:

- Communicating via email
- Researching information online

- ❖ Handling sensitive information in virtual ecosystems
- ❖ Safely using cloud-based collaboration tools like Google Drive, DropBox, and Microsoft Teams
- ❖ Creating and managing spreadsheets and online documents
- ❖ Basic device management like connecting to the internet or installing software updates
- ❖ Screen sharing during a video call
- ❖ Using online calendars and efficiently managing your schedule (and possibly others on the team)

8.10 Develop or Improve Digital Skills

Almost a third of the workforce lacks the foundational digital skills employers are looking for, meaning a large population of professionals need reskilling. Whether you're looking to sharpen your digital skills or you're hoping to enter the workforce with a strong resume, you can benefit from further training.

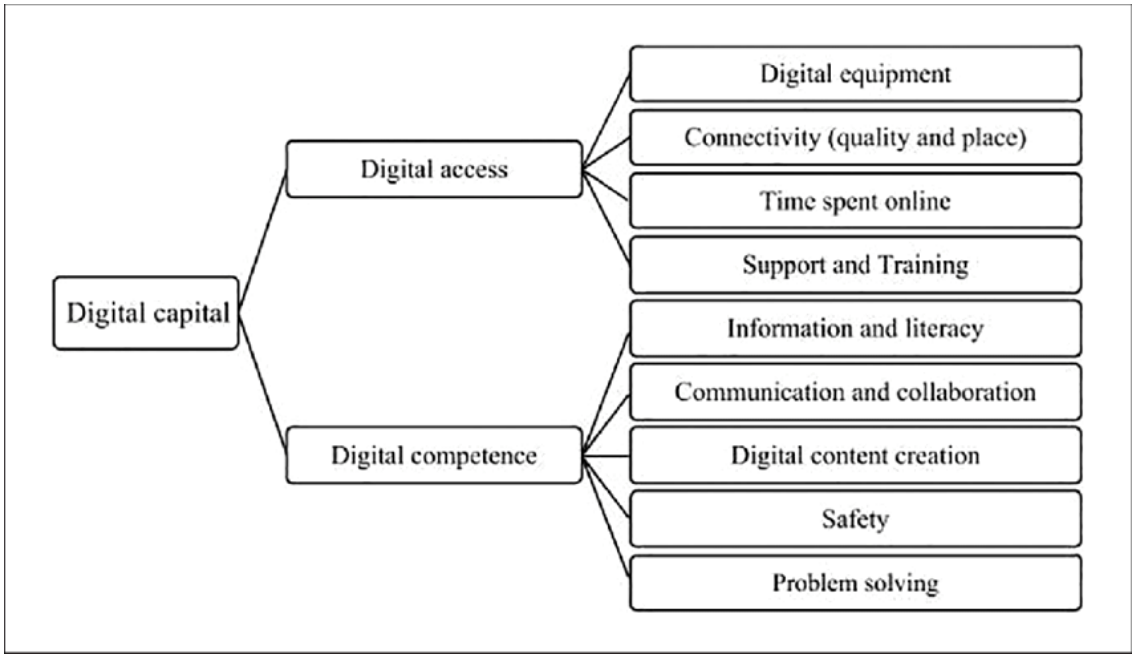

Figure 8.10 : Constitutive components of Digital Capital

Here are some methods for developing digital skills that don't include attending a traditional four-year college or university.

- **Self-Learning:** We've talked all about how technology is part of our lives, so we must acknowledge how critical it is in helping us learn. There is a vast amount of information

on any topic you can think of online, making basic skills easier to acquire. Connecting with professionals in our field is another great way to supplement our self-learning and understand which skills need more refining.

- **Free Online Courses:** For a more structured experience, we may want to explore free online courses that let ous learn at our own pace at a slightly deeper level than self-learning. We may not get all of the advanced material we need to land our dream job, but it's a step towards gaining basic knowledge and essential digital skills.
- **Certificate Programs:** Universities, like UNLV, offer dedicated certificate programs that deliver intense, in-depth instruction to ensure students are equipped with the digital skills and training to get them hired in today's workforce. Our digital skills bootcamps offer accelerated courses led by industry experts and help us to find the right job for ours with professional career coaching. We can even increase our professional visibility with our exclusive hiring partner network.

However, in a country of almost 1.4 billion people, with more than 80% being digitally challenged, the two schemes barely made a dent in reducing the technological divide. Although the government chalked this up to budgetary restrictions, just three months later, in February 2017, it approved yet another scheme – ***Pradhan Mantri Gramin Digital Saksharta Abhiyan (PMGDISHA)*** with an outlay of over $300 million, more than 6 times the combined expenditure made on NDLM and DISHA. This scheme was introduced with a more appreciable target of 60 million households. But, as highlighted in a report by the Parliamentary Standing Committee on Information Technology, it is riddled with design flaws, including an inadequate focus on qualitative parameters, weak post-training monitoring, lack of third-party audits, and insufficient fund allocation.

In terms of performance, the scheme is marred by non-achievement of targets; its deadline for completion was 31st March 2019, but so far, a little over 40 million have received training and barely 30 million have been certified. There is also evidence to suggest that the scheme is plagued with pervasive fraud. With the UN incorporating ***"digital literacy skills"*** as a thematic indicator under its Sustainable Development Goals, it is becoming increasingly evident that digital literacy is no longer a conspicuous privilege but an essential right. The physical constraints brought on by the COVID-19 outbreak have buttressed the need for strengthening the participation of citizens in the digital ecosystem. For the pandemic to be a catalyst for change, timely and concerted action by the government is imperative. Instead of rolling out multiple short-term schemes with similar objectives, an emphasis must be placed on implementing a comprehensive long-term scheme with perceptible outcomes.

Furthermore, the formulation of a national digital literacy policy, in consultation with the stakeholders, must be prioritized. By identifying and addressing challenges that are endemic to India, such as access to digital infrastructure, integration of regional languages, connectivity in remote areas, and representation of vulnerable groups (like women, differently-abled persons, below poverty line persons, scheduled castes, and scheduled tribes), such a policy could serve as a roadmap for effective government interventions. The European Commission's Digital Competence Framework for Citizens (DigComp) is a useful starting point in this regard.

Nonetheless, if the past efforts of the government are any indication, universal digital literacy will remain a distant dream for India. The abject passivity and rampant indolence of the government, as revealed by its slapdash patchwork of policies, has precluded any propitious development towards digital equity. Considering the rapid advancement of technology, it is likely that in the near future, digital inclusion will become inextricably linked with socio-economic progress. What remains to be seen is whether the government will embrace its self-professed goal of building a digitally empowered India or fall back to its pattern of announcing grand schemes that prove ineffectual at best, and disastrous at worst.

8.11 Summary

The effect of COVID-19 on the education sector cannot be overemphasized. The 5-month lockdown of schools disturbed learning, and only schools that had introduced their students to the electronic form of learning we're able to provide learning while other schools had to stay closed. Apart from the fact that the majority of these schools lacked the resources and infrastructure to carry out e-learning, most of their students do not even know how to operate a computer system, let alone operate the internet. Digital literacy is the ability to use digital technologies at an adequate level for creation, communication, collaboration, and information search and evaluation in a digital society. It involves the development of knowledge and skills for using digital devices and tools for specific purposes. The digital world offers numerous benefits to every one of us. It creates platforms that allow us to connect. It also opens up opportunities to learn about new issues and sets us up with skills and innovations that were unattainable decades ago. India, as we all are aware, is blessed with a huge population. It is a herculean task for the government to keep up with the development of such a diversified country. In our country, which has just started climbing up the ladder of development, struggling to take a step forward, digital literacy is a distant dream. We have almost 40% of the population below the poverty line, the general illiteracy rate itself is 25 to 30%, and digital illiteracy is more than 90%.

Digital literacy is different from computer literacy. It requires outstanding thinking skills, knowing how one is to behave in the digital world, and understanding the social issues that surround the digital world. Literacy means reading and writing skills. There was a time in history when we were formulating policies and working for literacy. Still, we have some more distance to travel before we achieve our goal of 100% literate India. Suddenly a tremendous development occurred in the Information and Technology sector, and now with the advent of the internet and with globalization, a certain segment of this massive population has tread forward and is motivated to be digitally literate. The word digital tacked before literacy, changes the meaning. 'Digital' is an elaborate topic, but in short, it is something that deals with technology.

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Dimensions of Livelihood in Rural India

CHAPTER - 09

Agriculture Sector for Sustainable Development in Rural India

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9.1 Introduction

The rural zone of any country is that area which is geographically located away from the cities or towns. The people of rural areas are usually engaged with agriculture sector for their subsistence. Although as literacy rate is increasing, people start migrating towards cities for better future but still about 68% of population of India continues to live in rural zones (2011) or we can say that more than half of population lives in countryside areas. During the time of independence, agriculture sector of rural area was the major contributor to GDP for uplifting the economy but now it is observed that the agriculture and associated services contribution to the GDP of the India has reduced considerably from 51.88% in 1950 to 16% as per the latest round of the Periodic Labor Force Survey (PLFS) for 2018-19.

Agricultural land (sq. km) in India was reported at 1796740sq. Km in 2018. Over the years, rural household dependency on agriculture sector has reduced to 50%. According to the 38th report of NSS and PLFS in the year 2018-19, the agricultural sector's contribution to employment decreased from 81% in 1983 to 58% in 2018. On the other hand, within the same period of time, non-agricultural rural employment, increased from 19% to 42%.

The workforce participation in rural non-agricultural sectors for male workers inclined from 22% in 1983 to 47% in 2018, thus visible increase of 25% point. Whereas female employment rate in the non-agricultural rural sector gradually enhanced from 12% to 29% within same time period. The literacy rate in rural areas is also starts increasing with time which brings awareness in villages.

According to World Bank the current rural population is reported at 898024053 in 2020 means, about 65.07 % in 2020 of total population of India lives in villages. Rural population growth (annual %) in India was reported at 0.29417 % in 2020.

9.2 Livelihood of Rural India

According to the definition given by the Institute of Development Studies, A livelihood comprises the capabilities, assets (including both material and social resources) and activities required for means of living. And a livelihood is sustainable when it can cope with and recover from stresses and shocks maintain or enhance its capabilities and assets, while not undermining the natural resource base. In simple term, it is about the people, who they are, what they do for living, what are the assets they have and their current living scenario. For the farming based household, livelihood strategies may be categorized into three sub groups.

9.2.1 Agricultural intensification

It refers to the utilization of a greater amount of agricultural resources such as seeds, fertilizers, machinery, labor, input etc for a given piece of area, in order to get higher output by increasing the productivity. As the population rate of country is increasing and area of cultivable land is decreasing, agricultural intensification is the feasible approach to maintain the food security of the country.

9.2.2. Rural livelihood diversification

It can be define as "The process by which rural families construct a diverse portfolio of activities and social support capabilities for their survival and to enhance their standard of living." With the increasing inability of agriculture to deliver in the post- liberalization era, as climate change, poverty and other uncertainties over which rural people have no control, there is a greater need of livelihood diversification. It can empower the livelihoods, helps villagers to cope with the adversity. It may strengthen the smooth consumption, stable income and meet adequate labor requirement.

9.2.3. Migration

People moves to other locations from their inhabitant to ensure a better livelihood. It may be for getting better education, job or better business and may be by compulsion; the daily wage laborers usually migrate to cities for getting works in off season.

9.3 Rural development

The term rural development can be defined as a process of enhancing the quality of life and economic well-being of people living in countryside areas. In India rural zone is predominately depend upon agricultural farming for their main occupation. According to the

report of Agricultural Census of India 2011, it was estimated that 61.5% of people dependent on agriculture. With the advancement, technological developments in the field of agriculture have boost up the gap between the rich and poor, as the rich one can afford the technology and increasing their profits whereas poor one still lacking behind.

In the period of advanced science, still large amount of population in rural areas are deprived of good education, adequate nutrition, proper communication, and social justice. Therefore, rural development is necessary. Rural development can be the outcome of interactions between various physical, technological, economic, socio-cultural and institutional factors. For example, if we really want to uplift rural area through agricultural activities, there is a need to change the mind of villagers toward modem agriculture; introduction of HYV of crops, precision farming, mechanization of farming, importance of organic farming, improved methods of irrigation, training of farmers for building capacities in modern agriculture; improvement of roads and communication system, provision of electricity, market etc.

As natural resources are declining day by day, it is important to aware and guide the farmers to quit traditional way of farming which blindly exploits natural recourses and move towards new sustainable approaches of agriculture. Earlier farmers are generally cultivate agronomical crops which degraded the land but in this modern era new approaches are available by which farmer can earn better and can conserve the environment.

9.3.1 Objectives of Rural Development

1. Increase the daily wages of rural individual on a self-sustaining basis.
2. Generate additional employment opportunities in rural areas.
3. To provide basic necessities such as elementary education, healthcare, clean drinking water, hygienic shelter, electricity, connectivity to cities, Mandi etc.
4. To guarantee an increase in the standard of living of the underprivileged population
5. To motivate and support farmers to involve in MSME and SSI projects. Motivate them to drop traditional way of farming and involve in start-ups programs.
6. To develop and empower human resource of rural area in terms of their psychology, skill, knowledge, attitude and other abilities.
7. To develop infrastructure facility of rural area.
8. To develop rural industries through the development of handicrafts, small scaled industries, village industries, rural crafts, cottage industries and other related economic operations in the rural sector.
9. To develop entertainment and recreational facility for rural mass.
10. To develop leadership quality of rural area.

11. To minimize gap between the urban and rural in terms of facilities availed.
12. To solve the problems faced by the rural mass for their development. And eliminate poverty.
13. To promote value addition and ensure a stable market for these agricultural products.
14. To bring improvement in producing of crops and animals living condition.
15. To develop rural area as whole in terms of culture, society, economy, technology and health.

Agriculture is not a word but a broad term which includes cultivation and marketing of not only plants but of livestock and other organisms such as fisheries, mushroom, bee-keeping, silkworms, pearls etc. Along with the production of commodities agriculture also deals with their processing and value addition. Agriculture is an integral part of the rural life and development. It plays an important part in their livelihoods. Cultivation of plants includes several branches such as:-

1) **Agronomical crops**:- it deals with the management of field crops (mostly annual crops) such as rice, wheat, barley, maize etc;

2) **Horticultural crops:** it includes production of fruits, vegetables, ornamental plants (flowers, trees, shrubs, climbers, succulents etc), medicinal and aromatics plants, spices and condiments, plantation crops and their processing. Other branches of agriculture

   - **Animal husbandry:** It concerned with management of domestic animals. It includes dairy farming, poultry farming, sheep husbandry, piggeries, goat farming etc.
   - **Apiculture:** it deals with rearing of honey bees for production of honey.
   - **Aquaculture:** it concerned with production of aquatic organisms such as fishes, aquatic plants, molluscs, crustaceans etc.
   - **Mushroom cultivation**: it deals with production of fungus such as button mushroom, oyster mushroom, shiitake mushroom, milky mushroom, paddy straw mushroom etc.
   - **Sericulture:**-it concerned with rearing of silk-worms and production of silkworms.

Role of agriculture in Indian economy

- Share in National Income
- Largest Employment Providing Sector
- Contribution to Capital formation
- Providing Raw Material to industries
- Market for Industrial Products

9.4 Reason for declining GDP contribution from Agriculture Sector

As population increased with time, problem of land fragmentation has been raised. Due to that agricultural land has been shrunken. At the national level, the average size of agriculture land has shrunk from 2.28 hectare in 1970-71 to 1.08 hectare in 2015-16.India has more farm laborers than farmers. The slower raise in the demand for food as compared with other goods and services, and the rapid development IT sector. Income insecurity and no fix MSP for all the crops trigger farmers to drop out farming. Moreover the scarcity of markets for selling yield is also one of the major reasons. As literacy rate rose, people want job security for that reason they quit farming. Some major internal factors such as insufficient public investment for agrarian development, inadequate irrigation facilities, government's poor agriculture-related marketing policies, inadequate access to institutional credit, half-baked land reform policy, and low return from agriculture are responsible for the fall in agricultural employment.

- **Some Effective Strategies for Rural Development**

The best strategy of rural development mainly focuses on poverty alleviation, provision of basic amenities, better livelihood opportunities and infrastructure facilities. It can be achieved with partnership with communities, non-governmental organizations, community-based organizations, institutions and industrial establishments.

1) The Department of Rural Development and Panchayat Raj is responsible for the implementation of various rural welfare schemes and also assists Panchayat Raj Institutions to discharge their duties and functions as effective Local Self-Government entities.

2) Water management for agricultural production by the Usage of sprinklers and drips which provide water efficiently ad can reduce insect-pest infestation.

3) Use of private companies for processing & marketing. Rural produces is the primary source for supplying raw material. Direct selling to middle main cause loss for farmers so either farmers can go for direct value addition or can cultivate for private companies. Enhancement of linkage to farmer groups with processors and buyers can increase the profits to the farmers.

4) Enhancing Rural Micro finance services & provision of subsidies for crops. Subsidies for farm machinery and Green House technology are also important.

5) Liberalization of Markets and Price Structures, MSP for all the crops can uplift the rural economy.

6) Better economic utilization of agricultural residues, by products & Recycling of wastes by the establishment of separate plants at the village levels by the support of government.

7) Pests and disease control with the usage of improved seeds, Bio-Fertilizers, Bio-Pesticides, Herbicides and resistant varieties etc.

8) Usage of advanced equipment and machinery that constitutes the technology for the plantation and harvesting of the crops that leads to decrease the labor cost.

9) Establishment of farmer care centers. Provision of Support to agricultural related industries

10) Analysis of complete Agricultural trade statistics includes Tree crops, Consumption data, Diseases and disease control data, Statistics on agricultural products processing & marketing, Fisheries statistics etc.

11) Increasing the organic farming, due to high utilization of fertilizers and pesticides by the farmers lead to contamination of food and natural resources. In order to amend this problem organic farming is the best approach. Moreover these organic products having high demand with better price. There is a great need to follow the organic farming by the Indian farmers and produce the organic foods and export to other countries for the propitiation. Worldwide the organic farming land increased 11-52% from 1990 to 2016.

9.5 Challenges or Problems in Rural Development

Peoples related

- Traditional way of thinking and personal ego do not allow them the adopt advancement.
- Illiteracy and poor understanding make them less confident to adopt new technology.
- Deprived of psychology and scientific orientation.
- Unawareness about new methodologies.
- Viii. Existence of unfelt needs which do not motivate to accept new techniques.

Agricultural related Problems

- Lack of expected knowledge, awareness, skill and positive attitude regarding new techniques and methodologies.
- Unavailability or poor availability of inputs resources such as inadequate irrigation facilities, electricity problem, unavailability of good quality seeds etc.

- No fixed MSP for all the crops leads to poor marketing facility. Moreover the problem of middle man is big hindrance for rural development.
- Iv. Fruits and vegetables are generally perishable or semi perishable in nature. But for their proper storage and transport, insufficient storage and transport system is present
- Small size of land holding due to land fragmentation as population increased.
- Unwillingness to work hard and stay in rural areas.
- High machinery cost or small farmers cannot afford good technological approaches such as Green houses. Maintenance cost of technology is also high.

Infrastructure and Economic related Problems

- Poor infrastructure facilities like electricity, water, transport, roads, communication, health, educational institutions, storage houses etc.
- Poor economic condition to adopt high cost technology.
- Underprivileged rural industries

Social, Cultural Problems and Leadership related Problems

Social, cultural problems and leadership related problems are found disagreement and conflicts among different castes, regions, groups, languages etc. Leadership among the hands of inactive and incompetent people or either in biased political hands.

Administrative problems

- ❖ Political interference
- ❖ Rudeness and corrupted behavior of administration.
- ❖ Lack of motivation and interest in rural life.
- ❖ Unwillingness to work in rural area.
- ❖ Improper utilization of budget.

9.5.1 Innovative Ideas for Rural Development in India

Startups: in rural areas labor is easily available moreover raw material required for any kind of industry is most of the time easily present in rural areas. The only need is of proper guidance and initial start-up funds. Other-wise rural areas have tremendous potential to build industry. For instance Agro based industry:-

- Vegetables and fruits are produced in rural areas, instead for direct selling they can be converted into pickles, jams, jellies, squashes, juices, sauces etc.
- Season based mushroom cultivation and its processing can generate huge employment and money.

- Sericulture is a tedious approach but once if it established it can provide jobs to men as well as women.
- Everyone wants pure honey these days, and in rural areas it is easy to rear honey bees hence apiculture can helps the farmers to get additional income
- Animal husbandry: value added product made up from dairy, poultry, piggeries, goat farming, sheep husbandry etc. all can work as side business or man business
- Silviculture in also a good approach for rural areas.
- As mostly natural water resources are available in countryside areas, aquaculture can also be practiced.
- Other small business such as making of woven basket from twigs, incense sticks, garlands, veni, gajras, gulabjal etc. such kind of start-ups can easily run by women.

9.5.2 Encourage Rural Entrepreneurship : it is very important to encourage small scaled entrepreneurs of rural society as they always lack in awareness, confidence and finance. So for them government has certain schemes such as:

- Prime Minister Employment Generation Programme.
- Centrally Sponsored Schemes (CSS) of Export Market Promotion.
- Dairy Entrepreneurship Development Scheme (DEDS).
- Development of Khadi, Village and Coir Industries.
- PM Mudra Yojana - MSME Loan / SME Loan Scheme.
- Entrepreneurship Development Institution Scheme.

No doubt these schemes are start by GOI but still practical implementation is very poor, rural people are not fully aware and are not benefitted by these.

9.5.3 Establishment of Rural Industries : countryside areas can start different kind of industries such as:

a) Agro Based Industries: Jaggery, Sugar industries, Oil processing from oil seeds, Pickles, murabbas, Fruit juice, jellies, james, Spices, Dairy products etc.

b) Forest Based Industries: Bamboo products, Wood products, Honey, Coir industry, making eating plates from leaves.

c) Mineral based industry: Cement industries, Stone crushing, Red oxide making, wall coating powders etc.

d) Textile Industry: Weaving, Spinning, Colouring and Bleaching.

e) **Engineering and Services :** Tractors and Pump set repairs etc. Small and medium sized industries to produce agricultural machinery, equipment for usage in rural areas etc.

f) **3.6**. **Handicrafts :** It includes making of wooden or bamboo handicrafts that are local to that area, traditional home decorative products, toys and all other forms of handicrafts typical to the region.

9.5.4 Organic farming : After green revolution land and food get deteriorate, to conserve the environment organic farming is the best approach moreover in rural areas it is easy to follow organic farming as organic manures are easily available.

Some other Rural Development Programmes

1. Etawah Pilot Project (1948).
2. Community Development Programme (1952).
3. National Extension Service (1953).
4. Intensive Agriculture District Programme (1960-61).
5. Area Development Programmes (1966).
6. Draught Prone Area Programme (1970).
7. Small Farmers Development Agency (1969).
8. Crash Scheme for Rural Employment (1971).
9. Command Area Development Programme (1976).
10. Special Life-stock Production Programme (1974-75)
11. Food for Work Programme (1977).
12. Integrated Rural Development Programme (1974)
13. Employment Assurance Scheme (1993).
14. Pradhan Mantri Gram Sadak Yojana (2000)
15. Swarna jayanti Gram Swarozgar Yojana (merger of IRDP, TRYSEM, DWCRA and Million Wells Scheme) (2001).
16. Mahatma Gandhi National Rural Guarantee Act (2005)
17. National Rural Livelihood Mission/ Aajeevika (2010)
18. Employment Guarantee Act [2005]
19. National Social Assistance Programme [1995]
20. PURA [2004-05]
21. Aajeevika Skills [2009)
22. Watershed Development (Revised – 2001).
23. HARIYALI [2003]
24. National Horticulture Mission [2005]

25. Support to State Extension Programmes for Extension Reforms [2005]
26. Rashtriya Krishi Vikas Yojana [2007]
27. National Food Security Mission [2007]
28. Mahila Kisan Sashaktikaran Pariyojana [2009]
29. Community Development Program [1952] and National Extension Services [1953]
30. Panchayati Raj [1959]
31. High Yielding Varietiy Programme [1960]
32. Indira AwaasYojana [1995]
33. Pradhan Mantri Gram Sadak Yojana [2000]

Ideas for Agro Based Industries as a startup in rural areas

- Fruit based processed food manufacturing industries (Jam, Jelly, Juice, Pickles, Syrup, Sauce, marmalades, murrabas etc.), Fruit (Apple, Mango, Banana, Guava, strawberry, Jackfruit, Litchi, Pineapple, Coconut, etc.)
- Vegetables and lentils processing industries
- Potato based food manufacturing industries (potato chips, potato flakes, starch etc)
- Jute based goods producing industries (thread, fabric, bag, carpet, sandal shoes etc)
- Silk fabrics or cotton production and clothing manufacturing industries
- Production of organic manures such as FYM, Vermicompost, Poultry manure etc
- Bee-keeping and honey collecting enterprises
- Sugar and jaggery (gur) production.
- Poultry and dairy farming industries.
- Flower preservation and exporting enterprises.
- Preparation of furniture made of wood, bamboo and cane.

Livelihood of Farmers lead to enhance by setting up a potential startup & value addition of products One of the examples are taken as a Mushroom cultivation and value addition .

9.5.5 Mushroom Cultivation & value addition may enhanced the Rural Economy

Nowadays mushroom is gaining high popularity due to taste acceptance and huge health and nutritional benefits. It can become a good alternative food for resolving the problem of malnutrition. In spite of this fact, mushroom cultivation and its utilization is not catching up fast because mushroom cultivation needs knowledge and experience and practice. Generally it is season based and off season cultivation is cost effective. Initial start-up unit establishment is also high, moreover mushrooms are highly perishable and it do not have proper market for selling. Hence mushroom processing is a potential approach. It can

achieve at small scale as well as on large scale especially in rural development. Value added products of mushroom not only cater to the protein and micronutrient requirement of masses but at the same time will solve the trouble of short shelf-life and postharvest losses of mushrooms.

Value Addition of Mushroom

Mushroom Pickle: In rural area, canning is bit typical process but pickling at home basis is easy to achieve for preservation of mushrooms to a value added product of high market acceptability. Mushroom like milky mushrooms are accepted as pickle than as fresh product.

Preparation of 1 Kg mushroom pickle : Requirements for 1kg mushroom pickle

1. 1 kg mushroom
2. Turmeric powder (20g),
3. Black mustard seed powder (35g),
4. Red chilli powder (10g),
5. Cumin seed powder (1.5 g),
6. Carom seed (10 g),
7. Nigella seed (kalonji) (10 g),
8. Fennel seed powder (1.5 g),
9. Salt (90 g) and mustard oil (200 ml).
10. Acetic acid (upto 100 ml) it is optional and
11. Sodium benzoate within the permitted limits as preservatives

01 kg mushrooms are washed in 0.03 to 0.05% KMS solution and placed for blanching for 5 min at 85°C. Then the blanched mushrooms are washed in cold water for 2-3 times and the excess water is drained off. Then the mushrooms are subjected to brimming (salt curing process) in which 20 g sodium chloride per kg of mushroom is added and kept overnight. The excess water that oozes-out of mushroom is removed on the next day.

After that mushrooms are allowed to dry for 2-3 hours and all the spices, salt and preservatives are added to the desired taste and quality of mushroom pickle. At last add heated mustard oil from the top to the mixture and blend with both hands, leave overnight for imbibing of spices and flavors development, fill in plastic/glass jars and again top-fill with mustard oil, close the caps and seal the jars and store pickle at shaded ambient place. This pickle can be stored up to one year in the airtight bottles.

Mushroom Preserve (Murabba) - Preparation of mushroom preserve

First the fresh buttons are harvested and are graded, washed, pricked and blanched in 0.05% KMS solution for 10 min. Then the blanched mushroom are dipped in 50º Brix sugar solution and refrigerated overnight. Next day mushroom are strained out of sugar solution and in that solution, add 0.1% citric acid and sufficient amount of sugar and heat it to attain strength of 60Brix. Strained mushrooms are then again dipped into that and kept overnight. This process is repeated to raise the concentration of syrup to 70º Brix and mushrooms are dipped into it for one week to prepare preserve. Then the preserve is drained out of sugar syrup and filled in a container with freshly prepared sugar syrup of 68º Brix. The containers are then sealed airtight and stored.

1. Mushroom Candy

The process for making candy is practically the same as that for mushroom preserve, the only difference is that the produce is impregnated with a higher concentration of sugar (75º Brix) and is also partially dried under shade to attain the chewable consistency. The mushroom candy can be stored up to 8 months with excellent acceptability.

2. Mushroom Biscuit

Button or oyster both the mushroom can be used to prepare delicious and nutritious mushroom biscuits using ingredients such as (i) refined wheat flour (*maida*) (ii) mushroom powder (in 80:20 or 90:10 ratio) (iii) sugar (30%) (iv) Ghee / butter (bakery fats) (45%) (v) Baking powder (0.6%), (vi) ammonium bicarbonate (0.3%) (vii) Salt (0.6%) (viii) Milk powder (1.5%) and (ix) vanilla essence (0.02%).

Preparation of biscuits

1. First all the dry ingredients are finely ground and sieved.
2. Add fats and sugar and mixed well for 5-7 minutes using Dough kneeder.
3. Then these ingredients are added to dough kneeder with other dry ingredients for dry mixing.
4. Thereafter, water is added to make dough cohesive and homogenous and mixing is continued till fully done.
5. Keep the dough for 10 minutes covered with wet cloth.
6. Thin sheets of dough (1.25 cm thick) are made and cut into different shapes of biscuits using different steel dies. These raw cut biscuits are then baked in hot oven

(at 180°C) for 20 minutes and after cooling pack the biscuits using suitable packaging material.

3. **Mushroom Papad**

Papads can be supplemented for protein with mushroom either in the form of paste or dried powder in the batter prepared from other sources.

Preparation of papad:-

1. First wash the harvested mushrooms in water (containing 300 ppm KMS).
2. Then blanched the mushrooms in hot water at 85°C for 5 min and immediately dip in cold water.
3. Cut mushrooms into pieces and make a paste in kitchen mixer grinder.
4. Thereafter boil potatoes in a pressure cooker, peel and crush/grate boiled potatoes to make a paste consistency.
5. Take blend potato paste and mushroom paste in 50:50 ratios and add spice into it such as salt, chilli powder, cumin, black pepper, etc as per taste.
6. Add KMS @ 300 ppm powder to the blend.
7. Spread the papad batter on a polyethylene sheet with appropriate round size (10 cm diameter) and uniform thickness (1-2 mm) on drying trays.
8. Keep the trays in sun for sun drying or in tray drier at 50°C for 5-6 hr to reduce the moisture content to 5%.
9. Peel off the dried papads from polyethylene film and pack in sets on 10-20 papads in one poly-bag.
10. Store in a cool and dry place.

Note: while consume the product, it has to be fried at 170°C for 60 to 90 sec in cooking oil.

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Dimensions of Livelihood in Rural India

CHAPTER - 10

Smart Technologies for Agriculture and Food industry

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10.1 Introduction

Agriculture is still the backbone of village economy and is also the largest employment provider in India. India is the largest producer of milk and milk products accounting for 17% of India's total expenditure on food items. We are the 2nd largest producer of fruits and vegetables in the world accounting for about 10 % of the population. Indian farmers, however, do not get adequate prices for their produce and they are forced to leave their produce in farms as they are unable to get the harvesting and transportation cost in the market. The market of processed food is growing exponentially in India. In spite of this fact we have not untapped the vast potential of food processing in providing mass employment as well as boosting the economy. Agriculture is an important sector of the world economy and a strong foundation for human life. It is the largest source of food grains and other raw materials. Agriculture plays a dynamic role in the growth of a country's economy. It is the primary source of income and very helpful for the development of the economic condition of the country. The development of machinery has increased the scale, speed, and productivity of farm machinery, leading to the successful cultivation of additional land. Seeds, irrigation, and fertilizers have also improved significantly, helping farmers to increase yields. Now, agriculture is in the early days of another revolution, in the heart of which there is data and communication. Artificial intelligence, analytics, connected sensors, and other emerging technologies can further increase yields, improve water efficiency and other inputs, and build resilience and resilience in all plant and animal husbandry.

Demand for food is growing at the same time the supply chain is facing global and agricultural issues. The world's population is on the verge of reaching 9.7 billion by 2050 which requires an increase of 70 percent of the available calories to use, as the input costs needed to produce those calories increase by 2030, water will be depleted. The 40 percent deficit to meet global water needs and rising energy, labor, and nutritional costs are already

under pressure. About one-fourth of the arable land is damaged and needs significant restoration before it can grow crops again at a high rate.4 Then there are growing environmental pressures, such as climate change and the economic impact of weather disasters, and social pressures, including pushing sustainable and sustainable farm practices, such as standards. The development is in the form of powerful and efficient machinery, and highly productive seeds and fertilizers lead more productivity. Now more and more digital tools are needed to bring the next generation of production. Some are already in place to help farmers use resources efficiently and effectively, while the most advanced ones are still being developed. These new technologies can improve decision-making, allow for better risk and diversity management in order to improve productivity and economic development.

10.2 Smart Farming

In the era of the industrial revolution new technologies, such as artificial intelligence, automated systems, and cloud computing have been developed to integrate the digital world with the rest of the world. One of the benefits of Industrial revolutionized is to provide a work environment that transcends equipment, infrastructure, and digital platforms. A variety of innovations, such as sensory technology, machine learning, wireless communication, configuration systems, and data viewing tools, have been authorized to create value and increase productivity in the agricultural sector. Due to environmental stress due to water scarcity, land misuse, soil erosion and greenhouse gas emissions, the demand for sustainable agriculture is increasing rapidly. The concept of sustainable development (SD) was developed in relation to the redesign of a vulnerable future. Environmental stress is seen as the result of increasing population growth, growth and technological advancement, and an increase in the standard of living within the economy. Sustainable agriculture needs a new system that protects and enhances the natural resource base while increasing productivity.

Traditionally, many diseases can’t be finding by farmers due to lack of knowledge and unavailability of local specialists. The basic requirements for agricultural development are the using of internet technology and future-oriented technology which act as a smart thing. Smart farming concepts, such as precise farming and land management, scientific data, such as landscaping and climate science, and advanced technologies, such as image processing, geographic information systems (GIS), and unmanned aerial vehicles (UAVs), improve agricultural production. Digital agriculture is the use of new and advanced technologies, integrated into one system, to enable farmers and other stakeholders within the agriculture value chain to improve food production. Farmers’ incomes in India are very poor and efforts

have to be made to enhance as well as their incomes may be doubling. For this, increasing the efficiencies of agricultural production processes and the entire value chain is important. Digital Agriculture is emerging as one of the ways to increase efficiencies and enhance incomes in agriculture globally. One of ways of enhancing farmer incomes is through the use of Digital Technologies in Agriculture to increase the overall efficiency of the agricultural production processes as well as the entire value chain.

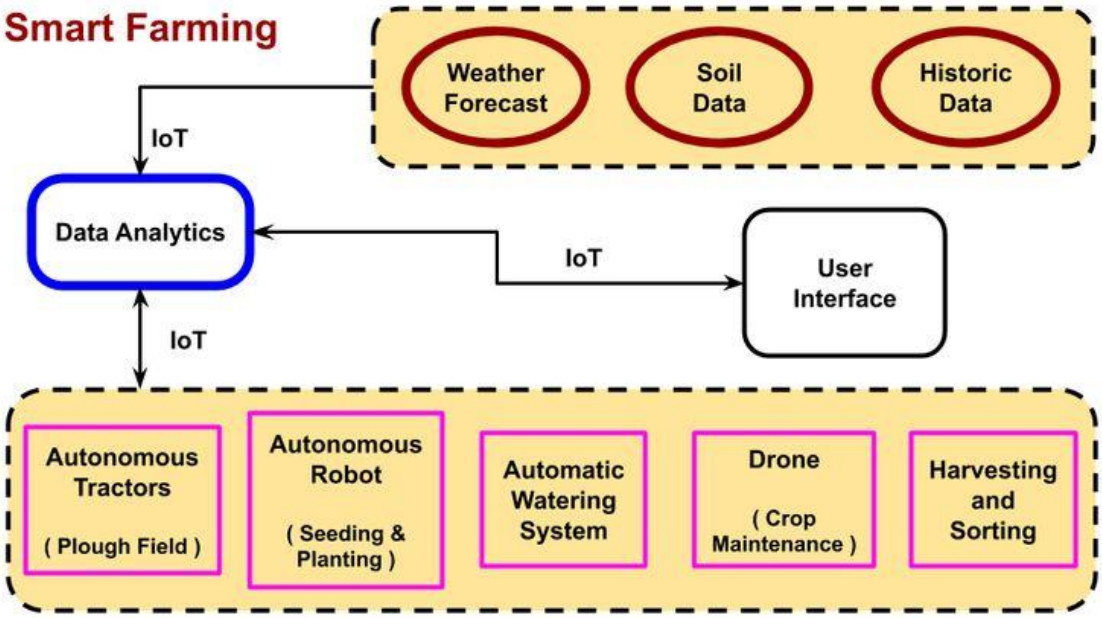

Figure 10.1 : Smart Farming - Future of Agriculture

"The future of food is unequivocally digital, and the future of digital is inevitably AI (Artificial Intelligence). From gene sequencing in seed production to Internet of Things (IoT) networks of implements and sensors that generate data and image recognition technologies that assay and grade crops and commodities, AI applications are being deployed across different aspects of agriculture. India's National Strategy on AI also aims to realize the potential economic and social benefits the technology offers. Further, the National Strategy on AI recognizes agriculture as one of the priority sector areas for implementation of AI driven solutions. Farmers can manage their crops and farms better if they can communicate their experiences, both positive and negative, with each other and with experts. Traditional agricultural farming can be smart agriculture by making suitable improvement in the existing solution. Farmers still far away from modern technologies and still relying on traditional methods of farming and food supply techniques have low productivity, and countries are producing yields much below their potential.

There are various data-driven strategies and analytical strategies that make agriculture smarter. The use of these strategies for certain specific features, such as data analysis, forecasting, measurement, and monitoring .The main purpose of by using different role of researchers, farmers, non-governmental organizations (NGOs), and everyone involved in the agricultural sector adopting various advance technologies to make agriculture simpler, more productive, and smarter. Technological development and digitalization shape feasible boundaries to increase resource use efficiency.

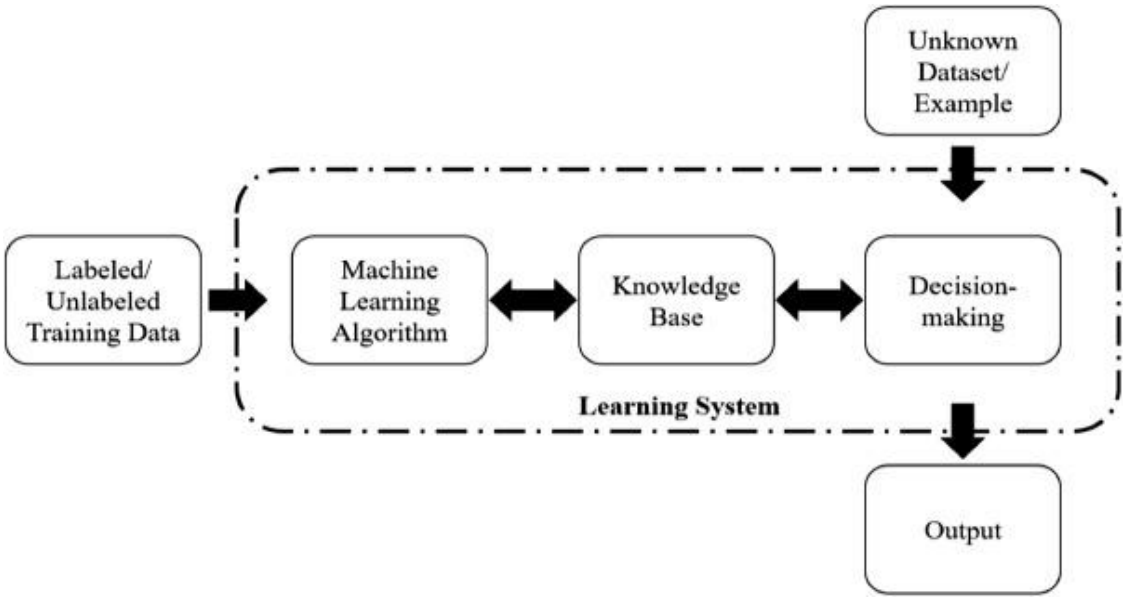

Figure 10.2 : Data Processing method in smart Agriculture

Smart agriculture reduces the negative environmental impacts of farming, increases resilience and soil health, and decreases costs for farmers. The number and types of challenges associated with smart farming expand across various agricultural production systems, and infrastructural limitations apply when it comes to IoT implementation.

10.2.1 Role of Image Processing in Agriculture

Image processing is a major step in agricultural development. Image processing is a method used to use an image to obtain an enhanced image or extract useful information from it. Image processing is a proven, effective process in the agricultural sector to increase productivity and sustain agricultural demand worldwide. Image processing with different spectral scales, such as infrared and hyper spectral X-ray imaging, helps to identify plant diseases, weeds, and a map of the world, which can help farmers reduce labor costs and time. Diagnosis of crop diseases will help farmers to control diseases and prevent them from

spreading the full crop. Providing image processing techniques in modern agriculture will enhance agricultural production to stabilize market demand and provide farmers with timely information using a variety of automated agricultural applications. The following section describes and analyzes different photographic processing applications in agriculture.

- **Plant disease identification**

Image processing is widely used for the identification of plant diseases in various agriculture crops. Farmers face major threats due to the emergence of various pests and diseases in the crops. Fungi, bacteria, viruses, and nematodes are some of the common reasons for disease infections. Traditionally, most diseases were not diagnosed or suspected by farmers, as they lacked knowledge about crop diseases and required support and suggestions from specialists. However, the diagnosis of infections in their early stages can mitigate crop damage. For identification of plant diseases, image processing plays an important role as the detection and identification of diseases is only done through visual information. A neural network-based methodology is suggested for disease detection and classification.

- **Fruit Sorting and Classification**

Varieties of fruits are distributed in markets for consumption as day-to-day activity increased demand from consumers. These fruits received from the market are sorted out manually, which is a biased, time-consuming, and tiresome process as large quantities of fruits must be sorted out in a short time. Image processing combined with other techniques can be used as expert advice to enhance production. Automatic sorting and classification of fruits is a postharvest process where the application of image processing is introduced for automation. This method is more advantageous than human labor with more accuracy, reliability, speed, and consistency. The industrial sector is more benefited by the automated sorting of fruits and vegetables by applying this nondestructive method of classification of Fruits with different size, color, shape and texture can be easily identified and separated. Damaged fruits and vegetables can also be easily identified and removed. This automation helps the industries, supermarket stores, and other wholesale fruit stores to sort the fruits in a shorter period with high accuracy.

- **Plant Species Identification**

Plant species identification is also an important application useful for botanist, researchers, and even the common man. Content-based image retrieval is used in the species identification from the collection of species images. Plants are identified by their morphological characteristics like texture, size, shape, and color of leaves and flowers.

- **Precision Farming**

Development in information technology and agriculture science has made it possible to merge these two sectors, leading to the rise of precision farming. This can assist farmers in making better decisions regarding optimal crop production. It involves proper understanding and efficient use of natural resources found within the field. It gives maximum profit and production with minimum input and optimal use of the resource. Farmers need pre acquired knowledge about technology and their workings. Proper training is required for farmers to acquire information about precision agriculture. The global positioning system (GPS) and GIS are the technologies used in agriculture equipment in precision agriculture. GIS is used to identify all available data, and GPS supports in identifying the object position on the globe using satellite signals. Remotely acquired images through satellites can be accessed and analyzed in their digital form. The advancement in image processing techniques has made remote sensing, along with GIS, progress independently. For better precision farming, an integrated system is used that consists of combining the remote sensing devices and image processing software package.

- **Fruit Quality Analysis**

Consumer awareness and demand for qualitative products in the market has demanded the development of an automation system for quality assessment. Fruit have good qualitative in nature. Fruit quality is analyzed by characteristics like color, shape, flavor, texture, and size. This computer vision task involves activities like image acquisition, processing, and interpretation for analysis. The fruits are graded into different categories based on quality. Different patterns and classifiers are used for grading. Color, size, texture, and shape are considered some of the important features for grading. Nowadays, in many industries, these computer vision-based automated quality assessment tools replace traditional manual inspection. Classifiers like neural network, SVMs, Bayesian decision theory, k-nearest neighbors (KNN), and PCA are used to grade the quality of fruits .Decisions of the automated system in the quality assessment are proved to be effective and supportive for numerous food industries. For quality estimation, color, shape, and size are the primary parameters to be considered.

- **Crop and Land Assessment**

Remote sensing is one of the important data sources used in GIS for accessing data acquired through satellites. The factor considered important in remote sensing is reflectance of visible light energy from an external source. The external source of energy for passive systems is the

sun. Information gathered through satellites has been increased through the use of image sensors. Remotely acquired images through satellites can be accessed and analyzed in their digital form. Advancement in image processing techniques like image enhancement, restoration and analysis has made remote sensing progress independently in advance of GIS. The main aim of remote sensing is to monitor the Earth's surface and thereby measure geographical, biological, and physical variables to identify the materials on the land cover for further analysis.

- **Weed Recognition**

Weeds are a threat to farmers in that they reduce crop production and quality. It requires more attention to monitor weeds. The use of herbicide is one of the standard method used to control the growth of weeds. With the latest innovations, weed recognition is automated such that the system automatically distinguishes weeds from crops. The automated system monitors weed growth regularly and decides the time of weed control

2. Role of Machine Learning in Agriculture

ML is a promising technology in modern farming. With the help of robots, ML can be used for spraying pesticides, fertilizers, and other chemicals in agricultural fields. The combination of ML and IoT makes it possible to monitor the status of a farm and estimate the exact damage severity. This would decrease the use of fertilizers by 70% by targeting only the effective areas. These applications of ML would decrease agricultural waste by 60%, which will help

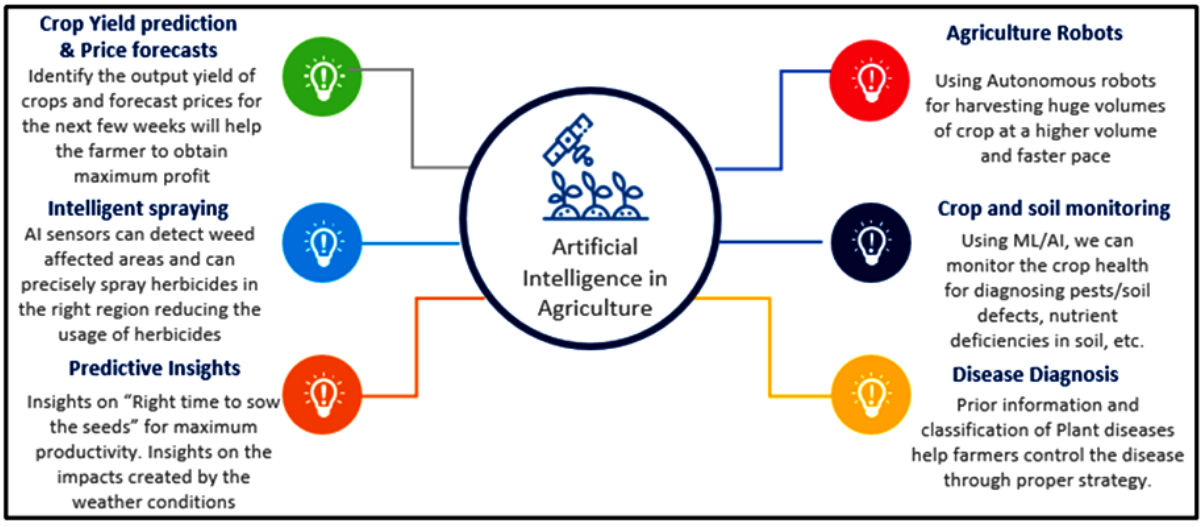

Figure 10.3 : AI application in smart agriculture

reduce the carbon footprint and protect the environment. This provides farmers with cost-effective and targeted solutions on their farm. ML with its huge applications can be used to perform an activity like crop prediction, crop management, and disease identification. ML models have been applied in multiple applications, such as crop management, yield prediction, and disease detection. Machine learning is everywhere throughout the whole growing and harvesting cycle. It begins with a seed being planted in the soil — from the soil preparation, seeds breeding and water feed measurement — and it ends when robots pick up the harvest determining the ripeness with the help of computer vision.

3. Role of Deep Learning in Agriculture

DL is a promising technology for the agricultural sector. DL is a subset of ML where ANNs, algorithms inspired by the human brain, learn from large amounts of data. DL can be used for crop management, prediction, and more. DL technology in modern farming with evolved algorithms is efficient and effective in the agro industry. DL in data analysis helps farmers analyze crops to get the desired output. DL, with its self-learning capability, is capable of using IoT for the advancement of water and soil management to empower yield production healthily. In regards to adverse effects of climate change and various environmental and economic factors affecting crops, DL helps farmers tackle these problems by species breeding to get specific genes for plants to adapt to climatic changes and become disease resistant. DL technology is a game changer in modern agriculture that can help sustain the agriculture sector.

Algorithms make crop prediction and crop management models much more precise and effective. At present deep learning, computer vision, image processing, robotics and IoT technologies are very supportive to farmers. AI based drone technology is very helpful for farming because it makes it easier to monitor, scan and analyze the crops by providing high quality images. This technology is useful to identify the progress of the crops. In addition, farmers can decide whether the crops are ready for harvest or not. There is no limit to describe the applications of deep learning in Agriculture even some of the applications of DL in agriculture are given below. The following diagram Fig shows the applications of deep learning in Agriculture.

4. Role of IoT in agriculture

To connect objects with a network for information exchange and communication, IoT technology is used. IoT is capable of making billions of interconnected devices that are also termed smart objects. These smart objects are proficient at collecting environmental

information and communicating with other systems through the internet (IoT-based applications enable devices to monitor and control in different domains, including processes,

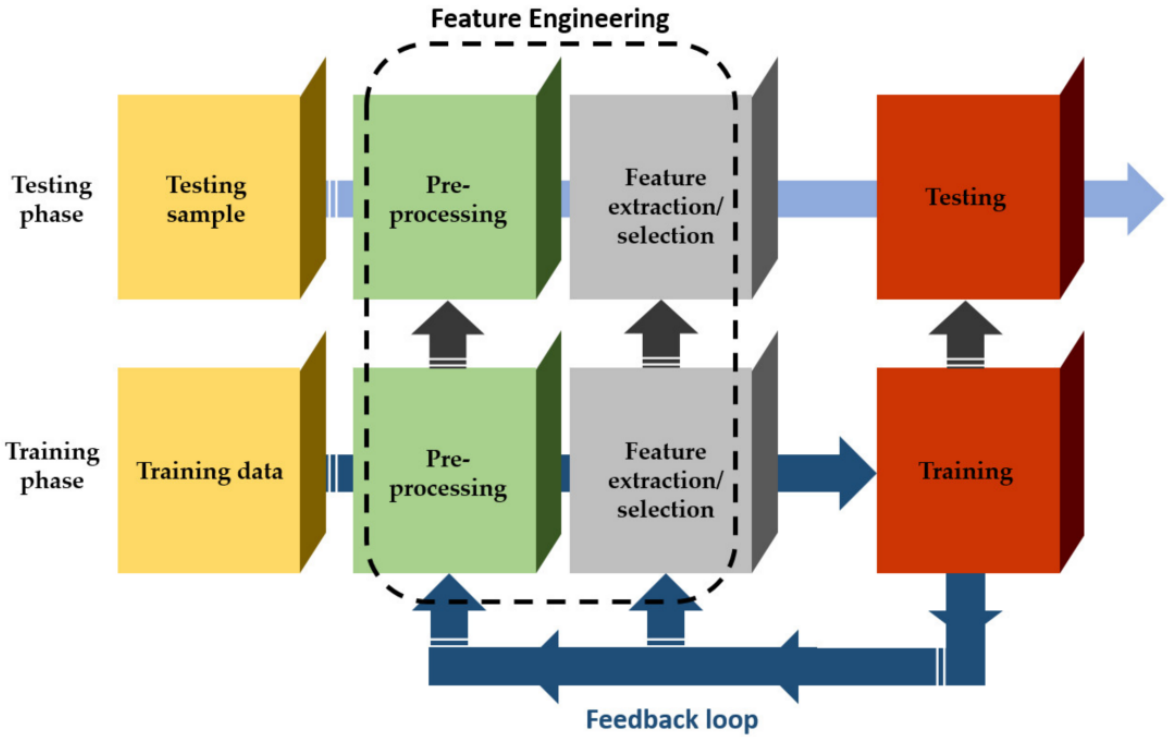

Figure 10.4 : Data processing in IoT based agriculture

home appliances, health monitoring applications, smart homes, smart cities, smart agriculture and more . IoT applications have unique importance throughout the lifespan of the agriculture sector, such as cultivate yields, irrigation, harvesting, post harvesting, crop storage, processing, transportation, and sales. For agriculture applications, there are a variety of specialized sensors available, for instance, soil moisture sensor, humidity, leaf moisture, solar emissions, infrared radiations, rain predictor, and more. In the scenario of IoT, sensors can be installed in different fields like greenhouses, seed storages, cold storages, agriculture machinery, transportation system, and livestock.

- **Crop Management**

Crop management is very important function to improve the quality of the crop. Nowadays drones are playing a vital role in crop management function of agriculture like crop monitoring, scanning of fields and so on. In smart agriculture, deep learning algorithms are used to monitor the temperature and water level of the crops. In addition to farmers can

observe their fields from anywhere in the world. This AI based smart agriculture is really efficient.

- **Water Management**

Water is requiring for proper growth of crop. Scrutiny the water level at regular interval is very important for the growth of the crops. Based on the crop and soil category we can efficiently manage the water level using machine learning algorithm. Artificial Neural Network (ANN) for smart irrigation system. It provides better water management in Agriculture.

- **Soil Management**

Using machine learning techniques we can easily recognize the suitable crops and best type of fertilizer for the soil is an easy task. Gaussian kernel-based SVM (Support Vector Machines), Bayesian Networks and ANN are mostly used for better soil management. The quality of soil depends on its pH level, EC, primary, micro and macro nutrients on the selected crop so the classification of the pH and relevant soil nutrient indices helps to examine the health of the soil.

- **Disease Detection**

Crop disease is a major threat in agriculture field. Disease detection at earlier stage in crops is a time consuming and tedious process when it is done by manually but with the development of AI and deep learning it is a less time consuming and easiest process.

- **Yield Prediction**

Each and every crop we need to concentrate on yield prediction. Machine learning and deep learning algorithms have been applied in crop yield prediction. It helps the farmers to decide on what to cultivate and when to cultivate.

5. Role of wireless sensor networks in agriculture

For sensing and analyzing the various parameters that are required in the agriculture domain, WSN technologies are available. To utilize sensors in agriculture, many applications have been developed. Sensor networks are the best options to make a strong bond between cyberspace and the real world. By design, sensors are appropriate for connecting agriculture to the IoT. WSN are cheap devices capable of working in specific environments for an extended period without battery replacement .The concept of precision farming is made clear, and the study of vital elements of precision and smart farming is done.

6. Role of Data Mining in Agriculture

"Big data" refers to a huge quantity of data gathered from the different channels for extended periods. Data collected from sensors, social networking, and business data is called big data. The big data have many challenges, like capturing, storage, investigation, and research. To cut production costs, big data is useful in the agriculture domain for maintaining supply chain management of agricultural products.DM and data analysis are key to increasing production at a low rate and getting maximum yield with maximum profit. DM uses existing technologies to bring a revolutionary change in the field of data mining

The term "Smart Food" is used to refer to foods which, through the application of technologies, preserve food safety, improve their nutritional benefits and healthy effect, better adapting to user needs and preferences. The future robotics, artificial intelligence and management control software are expected to play an even greater role in all areas from food processing to its packaging. More and more people are becoming aware of the type of food and drink they consume, & causing food borne illness, other diseases and complaints, and in short, their impact on health and well-being. Gradually the principle of "from one farm to another" becomes increasingly important and, as a result of this food safety and quality requirements link all stakeholders' food supply chain: production, processing, packaging, distribution, storage and home to prepare.

❖ Increased Demand for Food Safety Technologies

Over the last few years there has been an increase in the demand for profitable technologies enabling follow-up and sharing of information about food production and products. The efficiency of proactive control of expired or ill-treated food products, their traceability and alerts and corrective actions throughout the value chain has been related, among others, with the following technologies:

- bar codes and RFID
- sensors and chips
- microarray systems
- characterization techniques (X-rays, Ultra Violet, Infra Red)
- advanced diagnostic kits (single domain antibodies, bacteriophages, PCR)
- robotics and automation of supports related to diagnostic kits
- software solutions
- applications for mobile devices and smartphones for real time follow-up
- Cloud computing and cloud-based solutions.

- software as a service (SaaS)

The emerging technologies with probable impact over the next five years are:

- Artificial intelligence (AI)
- Blockchain
- Point-of-care devices (PoC)
- Printed electronics
- Thermosonication and UHPS
- Synthetic biology

Next generation technologies are AI, blockchain, PoC, printed electronics, thermo sonication and printed biosensors:

- **Artificial intelligence** is revolutionizing the food industry not only in regard to risk and safety, but also for the supply of raw materials, classification and storage of products, among others. Successful implementation of AI demands considerable technology readiness not only within the organization, but also for associated stakeholders. Practical application of the technology, combined with cost, performance and user acceptance continue to pose challenges in the wider adoption of AI.
- **Block chain technology** - implementation will strengthen food safety infrastructure considerably due to its impact on curtailing the problem of food contamination at the root. With Block chain, incidents of frauds will be easier to investigate due to the availability of a database related to the food item's production and supply chain. Block chain solutions are currently in their infancy and lack of proven use cases acts as a challenge for block chain deployments globally.
- **Point-of-care (PoC)**-food safety devices can guarantee timely intervention in the event of contamination during operations to reduce wastage in the retail chain. And with growing health awareness amongst general population, consumers can use these devices for instance to check the safety of restaurant foods, packaged foods, or marketed foods. Even though PoC devices are already present in the market, future expectations are for lab-on chip based hand-held devices and IoT-connected devices.
- **Printed electronics** plays a vital role in developing connected flexible components such as smart labels used for IoT applications. Advancements in printed electronics are poised to enhance food and beverage consumption safety for consumers through integration of different types of sensors and indicators.

- **Thermo-sonication and UHPH** are two techniques which are used, to varying degrees, for inactivation of enzymes and microbial growth. Their non-invasive, non-destructive, rapid and precise nature ensures safety and reliability, affecting longer preservation times and a reduction in additives after treatment.
- **Synthetic Biology** is an emerging technology that enables safer and healthier food as result of the powerful combination of various disciplines such as biology, design and engineering and information technology. Synthetic biology techniques will be ideal for designing crops and foods that are resistant to diseases.

The future of the global food and beverages sector: biosensors, genomics, enzyme technology, Big Data, 3D printing and packaging.

- The rapid advances in biosensor technologies and their convergence with Big Data platforms are expected to improve global food safety while at the same time providing new platforms for more precise food testing. They will also probably affect the food packaging industry.
- Unlike other technologies that will have a visible impact in the short term, genomics has more probability of a significant impact on global markets in the long term, influencing the substantial increase of world production of food with modified genetic traits.
- It is probable that the advances in enzyme technology will be driven by the greater use of genetic engineering platforms to improve the processing, extraction, yield and quality of a wide range of food products and beverages.
- Big Data platforms will have wide impact on various technological platforms for the use of emerging sequencing tools to improve global food safety in the near future.
- It is probable that 3D printing technologies will simplify clean, efficient printing of home-cooked food as well as gourmet products. The technological convergence

Advances in Packaging Technologies

Sustainable and safe packaging solutions are required that extend the shelf life of products. The evolving demands of consumers drive rapid advances in technologies packaging with the following emerging tendencies:

- Environment-friendly containers
- Smart container technologies
- Nano technological containers

- Use of hybrid materials
- Use of bio-materials such as bio-plastics
- Active packaging systems
- Edible packaging

7. Conclusion

"Smart farming" is an emerging concept that refers to managing farms using technologies like IoT, robotics, drones and AI to increase the quantity and quality of products while optimizing the human labor required by production. The Internet of Things (IoT) has provided ways to improve nearly every industry imaginable. The technologies driving the 'smart farming revolution' include the Internet of Things (IoT), edge computing, 5G, blockchain, AI, machine learning, robotics and drones. Some major technologies that are most commonly being utilized by farms include: harvest automation, autonomous tractors, seeding and weeding, and drones. Farm automation technology addresses major issues like a rising global population, farm labor shortages, and changing consumer preferences.

Companies like CropX are using sensors to detect moisture in the soil and help farmers create irrigation systems for crops based on soil moisture and temperature. This type of technology can help farmers become more sustainable by customizing water applications to the soil. Robotic systems can provide the perfect amount of irrigation, light, and humidity to produce crops indoors. Vertical farming, hydroponic farming, and aeroponic farming are all growing practices that utilize the modern greenhouse. The following technologies are currently used in agriculture to lessen the environmental impact: Robots: Help track the health of crops by monitoring sensors and precise locations of problems. Moisture and temperature sensors: Monitor the soil so farmers can make the best decisions on when to water and plant. The advent of mobile-based apps and integration of technologies such as QR-based menu display, contactless payment, online customization of meals, tracking and tracing of ingredients, and AI-enabled smart cameras are transforming the foodtech industry.

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Dimensions of Livelihood in Rural India

CHAPTER - 11

Animal Husbandry and Livestock Management in Rural India

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11.1 Introduction

Animal Husbandry is making a significant contribution to the national economy and socio-economic development in the country. In rural India where over 15-20% families are landless and about 85% of the land holders belong to the category of small and marginal farmers, livestock farming is the main source of livelihood security and socio-economical upliftment especially in rural area. Hence, Animal Husbandry is an economic enterprise & considered as "Survival enterprise" for millions of people in India. In India, about 85% livestock keepers are small & marginal farmers having less than 2 hectare of land, operating 44% of land for crop cultivation & contributing more than 69% in country milk production. Future of sustainable agriculture growth & food security in India depends on the performance of small & marginal farmers. Livestock is an engine for economic diversification and sustainable rural development. It serves as a lifeline since it provides livelihood to two-third of rural community giving employment to large population of unskilled youth. Livestock contributes 16 percent to the income of small farm households as against the national average of 14 percent for all rural households.

Not only this, livestock sector provides employment to 8.8 per cent of population which largely comprises of landless and unskilled population. In the livestock sector, the dairy sub-sector has always played an important role. This is quite evident from the words of Nanda Kumar, Chairman National Dairy Development Board (NDDB) that "Doubling farmers' income by 2022 is impossible without dairy farming which has a CAGR of 19.6 per cent. 85 per cent of the farmers in India who are marginal and small own 45 per cent of the land, but 75 per cent of the bovine. So probably for a landless person, dairying is one of the best occupations". Moreover no one is left untouched from the commendable position of India in the world in milk production accounting for 18.5 per cent of world production (789 million

tons). The monetary value of this is more than the current combined value of rice and wheat, and this was achieved without subsidy and incentives. We are fortunate that our country has a big diversity in terms of livestock population and productivity. The total milk production in India in 2019-20 is 198.40 millions tonns/day and per capita milk availability reached up to 406 gram/day.

There is scope in terms of livestock population as well as in livestock diversity in our country. The total Livestock population is 535.78 million in the country showing an increase of 4.6% over Livestock Census 2012. Total Cattle Population in the country is 192.49 Million, total buffalo population is about 109.85 million, total Bovine population (Cattle, Buffalo, Mithun and Yak) is 302.79 Million in 2019 which shows an increase of about 1% over the previous census. Cattle and buffalo depicts relatively low growth rate of 1.34 and 1.06 per cent respectively. The number of small ruminants like sheep and goat had shown a significant increase with 14.1 per cent and 10.1 per cent growth rate respectively. The Population of pig, yak, horses & ponies, mule, donkey and camel had shown a negative growth rate. India ranks first in Buffalo population, second in goat population, third in population of sheep, fifth in camel population in world.

11.1.1 Importance of livestock sector in terms of livelihood security

1. The livestock provides food items such as milk, meat and eggs for human consumption. India is number one milk producer in the world. It is producing about 198.40 million tones of milk in a year (2019-20). Similarly it is producing about 114.38 billions of eggs, 8.80 million tonnes of meat in 2020-21.
2. The livestock also contributes to the production of wool, hair, hides, skin and pelts. Leather is the most important product which has a very high export potential. India is producing about 51.5 million Kg of wool per annum during 2019-20.
3. Bullocks are the back bone of Indian agriculture specially in the rural condition. Despite lot of advancements in the use of mechanical power in Indian agricultural operations, the Indian farmer especially in rural areas still depend upon bullocks for various agricultural operations. The bullocks are saving a lot on fuel which is a necessary input for using mechanical power like tractors, combine harvesters etc. Pack animals like camels, horses, donkeys, ponies, mules etc are being extensively used to transport goods in different parts of the country in addition to bullocks. In situations like hilly terrains mules and ponies serve as the only alternative to transport goods. Similarly, the army has to depend upon these animals to transport various items in high areas of high altitude.

4. Dung and other animal wastes serve as very good farm yard manure and the value of it is worth several crores of rupees. In addition it is also used as fuel (bio gas, dung cakes), and for construction as poor man's cement i.e. dung.

5. Livestock offer security to the owners and also add to their self esteem especially when they own prized animals such as pedigreed bulls, dogs and high yielding cows/ buffaloes etc. 6. 6. Livestock serve as an asset and in case of emergencies they serve as guarantee for availing loans from banks.

6. Livestock are also used as Biological control of brush, plants and weeds.

7. The livestock plays an important role in the economy of farmers. The farmers in India maintain mixed farming system i.e. a combination of crop and livestock where the output of one enterprise becomes the input of another enterprise thereby realize the resource efficiency. 9. Livestock is a source of subsidiary income for many families in India especially the resource poor who maintain few heads of animals. Cows and buffaloes if in milk will provide regular income to the livestock farmers through sale of milk.

8. Animals like sheep and goat serve as sources of income during emergencies to meet exigencies like marriages, treatment of sick persons, children education, repair of houses etc. The animals also serve as moving banks and assets which provide economic security to the owners.

9. A large number of people in India being less literate and unskilled depend upon agriculture for their livelihoods. But agriculture being seasonal in nature could provide employment for a maximum of 180 days in a year. The landless and less land people depend upon livestock for utilizing their labour during lean agricultural season.

10. The animals offer social security to the owners in terms of their status in the society. The livestock sector accounts for 40% of the world's agricultural Gross Domestic Product (GDP) and about 1.3 billion people depend upon livestock husbandry for their livelihood. This sector alone contributes nearly 25.6% of value of output at current prices of total value of output in agriculture, fishing and forestry sectors. The total livestock population in India is about 535.78 million (2019).

The present breedable bovine population under an organised breeding programme is 113.61 million, which includes 12.62 million crossbred, 51.13 million indigenous cattle and 50.28 million buffaloes. India also tops in milk production, with 100 million tons/year. The value of output contributed by livestock in 2003-04 was Rs.164,509crores, of which Rs.110,085 crores (66.92%) was from milk and the rest from meat. Livestock also provides gainful employment

all-round the year to over 16 million people, of which 70% are women. Milk production accounts for 5.86% of the GDP while the total contribution from Animal Husbandry is 9.33%.

Table 11.1 : Livestock Population in India (20th livestock census)

Species	Population in Million (2012)	Population in Million (2019)	% Growth
Cattle	190.90	192.49	0.83
Buffalo	108.70	109.85	1.06
Sheep	65.07	74.26	14.13
Goat	135.17	148.88	10.14
Pig	10.29	9.06	-12.03
Mithun	0.30	0.38	26.66
Yak	0.08	0.06	-25.00
Horses & Ponies	0.63	0.34	-45.58
Mule	0.20	0.08	-57.09
Donkey	0.32	0.12	-61.23
Camel	0.40	0.25	-37.05
Total livestock	512.06	535.78	4.63

The livestock productivity, reproducibility and profitability is poor because of lack of scientific rearing of dairy animals, poor availability of good quality germplasm, lack of feed & fodder resources throughout the year, lack of adequate knowledge about animal health programme and various preventive measures. However, Government of India initiates several livestock development programmes to improve the livestock productivity as well profitability, so that a livestock owner's socio economic upliftment could be possible in better way.

11.2 Strategies of Government of India to secure livelihood security

The Government of India had given major thrust on the following activities under the Tenth Five Year Plan.

- Genetic up-gradation of cattle and buffaloes and improvement in delivery mechanism of breeding inputs and services to farmers including promotion of clean milk production;
- Extension of dairy development activities in non-operational flood, hilly and backward areas;
- Provision of nutritious feed and fodder through promotion of fodder crops and fodder trees;

- Provision of adequate animal health cover services including creation of disease free zones and control of foot and mouth disease;
- Improvement of small ruminants;
- Provision of credit facilities to farmers.

To achieve the above goal, the Government adopted the following strategy.

- Expand and strengthen infrastructure for artificial insemination, improve efficiency and effectiveness by using frozen semen technology for cross breeding;
- Create a germplasm bank of superior bulls and bull mothers to serve as a nucleus germplasm pool;
- Facilitate genetic improvement of important native breeds through selective breeding and crossbreeding of low productive non-descript stock for both milk and drought purposes;
- Improve productivity of pasture lands, through introduction of improved fodder varieties and development of wastelands for forage production;
- Provide animal health services with special emphasis on control of foot and mouth disease;
- Promote technological inventions for adding value to livestock products;
- Improve the database of livestock performance and products.

The following schemes were also launched by the Government of India for betterment of livestock health and productivity.

1. **Central Cattle Breeding Farms:** Support to farmers engaged in production of indigenous and exotic bull calves of Tharparkar, Red Sindhi, Jersey, Holstein Friesian and crossbred cattle and Surti and Murrah buffaloes. However, these farms together produced only about 350 bull calves in 2004-05.

2. **Central Frozen Semen Production Laboratory** in Bangalore produced 12 lakh doses of semen in 2004-05.

3. **Central Herd Registration Scheme (CHRS):** It was launched to register elite cows and buffaloes of important native breeds and to provide incentive for calf rearing. Four units established at Rohtak, Ahmedabad, Ajmer and Ongole are engaged in laying down selection standards and identification of superior germplasm of Gir, Kankrej, Haryana and Ongole breeds of cattle and Murrah, Jaffrabadi, Surti and Mehsana breeds of buffalo. About 11,000 elite cows and buffaloes have been registered during 2004-05.

4. **National Project for Cattle and Buffalo Breeding (NPCBB)** initiated in 2000 aims at genetic upgradation and conservation of important indigenous breeds through introduction of superior bulls for breeding, quality control of semen banks, promotion of private mobile AI service at the doorsteps of farmers, streamlining the distribution of liquid nitrogen and restructuring of the institutional infrastructure

5**. Feed and Fodder Development:** Seven Regional Stations and a Central Station have been established for production of fodder seeds and to set up field demonstrations. Establishment of fodder banks, enrichment of agricultural by-products and supply of fodder mini kit are the major initiatives to enhance the feed supply.

6. **Livestock Health:** Apart from supporting biological products units, disease diagnostic laboratories and livestock disease control programme, special programmes have been launched to control Rinderpest and Foot and Mouth diseases.

7. **Dairy Development:** Major schemes launched to tap the potentials of dairy husbandry were:
    a. Dairy venture capital fund;
    b. Integrated dairy development in non-operational flood, hilly and backward areas;
    c. Assistance to dairy cooperatives;
    d. Promotion of private dairy processors;
    e. Strengthening infrastructure for clean milk production.

8. **The programmes of NDDB :** The Perspective Plan 2010 covers strengthening of cooperative business, enhancing productivity, managing quality and building a national information network in the operational flood areas.

11.2.1 Programmes of the State Governments

Based on the priorities set by the Government of India, most of the State Governments had launched the following schemes.

- Treatment of sick animals and preventive vaccination;
- Breeding services;
- Management of cattle farms, calf rearing, fodder demonstration farms, fodder banks, veterinary clinics;
- Support to Goshalas for breed conservation and production of elite animals.

Lack of funds to procure vaccines and delay in supply from the state owned Production Units are often rendering the programme ineffective. Moreover, these programmes could not reach the small farmers in remote areas.

11.3 Constraints of Livestock Development

In spite of the ambitious programmes launched by the Government of India and State Governments, they were not able to deliver the expected results. There was no significant breakthrough in improving the productivity both in the milch and meat sectors and in reaching the poor for their livelihood.

The reasons for the slow progress were:

- Non-availability of superior quality breeding bulls;
- Poor quality of semen produced by many of the laboratories;
- Inadequate skills of para-vets resulting in poor conception and infertility;
- Inadequate support for paravets for supply of liquid nitrogen, frozen semen, health care and technical guidance;
- Shortage of fodder resources;
- Absence of field oriented conservation strategy for indigenous breeds;
- Lack of coordination among various agencies engaged in livestock husbandry;
- Poor extension services to motivate small farmers to adopt dairy husbandry for income generation. If the programme has to reach the poor and make a positive impact for its success, it is necessary to sort out the problems of the poor. The major problems of the rural families living below the poverty line (BPL) in taking advantage of the opportunities in livestock development are presented below :
  a) Poor quality animals needing genetic upgradation and severe culling;
  b) Poor breeding services at their doorsteps, both with respect to superiority of the germplasm and timely and efficient delivery resulting in poor conception and production of inferior quality offspring;
  c) Nutritional deficiency, shortage of feed and fodder;
  d) Poor health conditions due to lack of preventive vaccinations and timely diagnosis of health problems;
  e) Lack of coordinated efforts to eradicate common diseases;
  f) High cost of veterinary services leading to neglect of sick animals;
  g) Spreading of communicable diseases such as Brucellosis, TB, etc. to other animals as well as human beings in the absence of separation facilities;
  h) Lack of technical guidance to farmers to improve their animal husbandry practices;
  i) Poor control on technicians engaged in providing various services to farmers resulting in exploitation and lack of treatment for infertile animals;

j) Saturation of market in local milk sheds, resulting in lower price realisation and exploitation by the middlemen and private dairies;
k) Poor linkage between research institutions and farmers resulting in use of outdated technologies;
l) Absence of suitable policies to involve small farmers.

11.4 Strategy for Livestock Development for Benefiting Small Farmers

Keeping in view the performance of various schemes, the following recommendations can be made to boost livestock husbandry, which can boost the production, compete in the global market and attract the landless and small farmers to take advantage of this sector for sustaining their livelihood.

1. **Genetic Improvement**
    a. Production of Superior Quality Bulls
    b. Production of Superior Quality Semen
    c. Conservation of Genetic Resources
2. **Breeding Services and Management**
    a. Training and Regulation of AI Technicians
    b. support & Health services at door step of the farmers
3. **Feeding management**
    a. Efficient management of crop residues
    b. Improvement of Nutritional values
    c. Development of pasture/grassland
    d. Complete feed rations
    e. Establishment of fodder banks
    f. Innovative feeding methods

Hence, now it is well understood that animal husbandry is the most important component of Indian agriculture supporting livelihood of more than two-thirds of the rural population especially marginal, small & landless farmers of our country. Animals provide nutrient-rich food products, draught power, dung as organic manure and domestic fuel, hides & skin, and are a regular source of cash income for rural households. The growth of livestock wealth in India is at the rate of approximate 6% per annum. Animals provide nutrient-rich food products, draught power, dung as organic manure and domestic fuel, hides & skin, and are a regular source of cash income for rural households.

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