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Role of National R&D Institutes in Devising Novel Strategies for Empowerment of Weaker Sections of Society in India

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Abstract

India has a rich scientific base and is marching ahead as a knowledge-based economy. It has several government-funded R&D institutions (under Indian Council of Agricultural Research [ICAR], Council of Scientific and Industrial Research [CSIR], Indian Council of Medical Research [ICMR], Department of Biotechnology [DBT], Department of Science and Technology [DST], etc) that have mandates that ultimately aim towards empowerment of weaker sections of society and eradication of poverty mainly in rural areas. Significant among the R&D institutes are the ones that have launched programs for agro-based small-scale rural entrepreneurship. As an example, CSIR-CIMAP, Lucknow has launched a mission *Sakshama* scheme that honors/awards women entrepreneurs in the area of medicinal and aromatic plants (MAPs). One of the pioneering activity under this mission has been training rural women on making rose water and *agarbattis* (incense sticks) by reusing rose flower petals offered to the deity at temples. This scheme is eco-friendly as well as helps women to earn additional income through self employment. The unique Biovillage Mission approach of CSIR-CIMAP has been instrumental in catalyzing the establishment of functional value chains between the four major partners (farmers, industry, financial bodies and scientists) of MAP products trade. The ICAR has also played a key role in the Green Revolution and subsequent agricultural improvements in India through its R&D that has enabled the country to increase its agricultural production. This paper discusses case studies from Indian R&D institutes that have made a significant impact on societal development through empowerment of weaker sections of society.

Keywords

Biotechnology, Empowerment, Entrepreneurship, Mission, R&D

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1. Introduction

India has a great past, present and future in science. Today it has one of the fastest growing knowledge-based economies of the world. Although it is faced with an ever increasing population burden that has been the main culprit for poverty in the country it has a strong scientific background to find rationally-designed solutions to its problems. The Government of India has established a network of state-of-art national R&D institutions for both basic as well as applied research under its agencies like Indian Council of Agricultural Research (ICAR), Council of Scientific and Industrial Research (CSIR), Indian Council of Medical Research (ICMR), Department of Biotechnology (DBT), Department of Science and Technology (DST), etc. Among these R&D institutes, the ones that have launched programs for agro-based small-scale rural entrepreneurship are playing important role in poverty alleviation through empowerment of weaker sections of Indian society, mainly comprising of

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scheduled castes, scheduled tribes, other backward classes, minorities, women, and people living below the poverty line (BPL) (Venkateswarlu, 2013). It must be pertinent to note here that the Human Development Index (HDI) is a combination of three parameters: (i) sound health – measurable by life expectancy at birth, (ii) knowledge – measurable by literacy and education, and (iii) decent standard of living - measurable by per capita income. The mantra of *Science for Society*, which is a powerful driving force for the Indian R&D institutes aims precisely towards increasing the HDI of Indian masses.

Empowerment of weaker sections in any society requires increased opportunities, removal of social barriers and mitigation of financial risk employing a bottom-up approach (Bandyopadhyay, 2007). Science and technology provide the vehicle to facilitate these aspects and ensure improvement in the standard of living of the masses. It is an undeniable fact that science plays an important role in the "developing" to "developed" transition for any nation. Other factors being equal, the larger the scientific R&D base in a country, the higher is the chance of its moving smoothly and quickly on the path of progress and inclusive growth. How this could happen could be probably understood if we take a look at the progressive growth of post-independence India. In this direction the following case studies and examples highlight the role played by national R&D institutes towards empowerment of weaker sections of the Indian society.

2. CSIR Initiatives

2.1. Medicinal and Aromatic Plant (MAP)-Based Missions

Several programs have been launched for the benefit of the rural population that are based on medicinal and aromatic plant usage.

2.1.1. Biovillages

One of the CSIR laboratories, CSIR-Central Institute of Medicinal and Aromatic Plants (CSIR-CIMAP), located at Lucknow has successfully launched unique *Biovillage Missions* for rural participatory development through development of end-to-end technologies for medicinal and aromatic plants (MAPs). *Artemisia annua* (known for producing the antimalarial drug artemisinin), Patchouli, Geranium (cultivated for its essential oil on small land holdings) and Khus *Biovillage Missions* have been very popular and aimed at the establishment of functional value chains between the four major partners (farmers, industry, financial bodies and scientists) of MAPs trade. The value chains so formed have inherent incentives for indigenous knowledge providers and a built-in obligation for the MAPs-based industry to invest a part of its profits back into the system for sustenance and conservation of MAPs. The farmers have been empowered through provision of critical information about prices, market availability, demands and supply chains of MAPs, post-harvest management of crops as well as easily accessible soft loan facilities. The underlying aim is the capacity building of farmers leading towards an increase in their negotiating and bargaining power. Another aspect that has been addressed by biovillages is that earlier most of the trade in MAPs was usually occurring in bulk raw material that gave less economic returns to the farmers but now intensive efforts have added more value to raw MAP-based products and created value-added and value-enhanced organic MAP-based products that fetch better returns for the entrepreneurs. CSIR-CIMAP has taken a lead in this direction by developing several herbal products that have been well received by the market in India (Table 1).

2.1.2. *Sakshama* (The Enabled Woman)

This mission of CSIR-CIMAP, as its name implies, aims at empowering women of rural India. It honors and awards women entrepreneurs working in the area of MAPs. One of the flagship activity under this mission has been training rural women on making rose water and *agarbattis* (incense sticks) by re-using rose flower petals offered to the deity at places of worship (like Chandrika Devi Temple at Lucknow). In the past this DBT-sponsored training program has helped several women coming from Lucknow, Barabanki, Raebareli and nearby districts. This scheme is eco-friendly as well as helps women to earn additional income through self employment without disturbing their routine assignments in life.

2.1.3. *Kisan Melas* (Farmer Fairs)

R&D institutes like CSIR-CIMAP as well as agricultural universities across the country regularly organize *Kisan Melas* for educating the farmers about latest technologies that they could adopt towards higher productivity from their agricultural efforts (CIMAP, 2011). It provides an interactive platform for scientists, farmers, industry and financial institutions to discuss the aspirations and feedbacks from farmers so as to enable targeted agricultural research. These fairs are also suitable platforms for showcasing innovative tools for small scale entrepreneurs like for example, "CIM-Asvika", the portable distillation unit designed for essential oil extraction from aromatic plants by small farmers and entrepreneurs.

2.2. Other Programs for the Masses

CSIR is also operating other projects like the CSIR800 aimed at empowering 800 million Indians (especially those at the bottom of the *pyramid of quality of life*) through utilization of

benefits of cutting-edge science and devising innovative solutions in the area of health, agriculture, and energy, as for example, technologies for mechanized agriculture, low cost housing, new cultivation techniques, water purification techniques, Soleckshaw (a Solar Electric Rickshaw or pedicab) and traditional ceramic products using local based inputs (CSIR, 2011). CSIR has also provided relief during national calamities like cyclones, tsunami (in 2004), or earthquakes, whereby it undertook the largest production of instant food through its R&D labs (providing 55 tonnes of food) and also made available sweet drinking water through reverse osmosis and electro-dialysis techniques; and extended support through large scale geo-engineering experiments. Cost effective drugs (antimalarials — elubaquine and arteether, technology for oral insulin and hepatitis B vaccine, anti-HIV cocktail etc) have also been developed for the poor (CSIR has developed eleven of the fourteen drugs that have been developed in India).

Table 1. Herbal formulations based on traditional knowledge or direct output of the research developed by CSIR-CIMAP. (Ref. CIMAP Formulations Brochure)

S. No.	Product Name	Quality/Activity	Uses	Status
Skin Care				
1.	Cracknil	Anti-crack cream	Effective on cracked heel and chapped hands	US Patent No. 6,126,950
2.	Myconil	Anti-fungal cream	Effective on fungal infection	US Patent No. 7,291,349
3.	HAloe Skin	*Aloe vera*-based all purpose cream	Effective on cracked heel, chapped hands, dry skin and eczema	CIMAP know how
4.	Kleenzie	Face wash	For effective cleaning and moisturizing	CIMAP know how
Hand Disinfectant				
5.	Hankool	Hand disinfectant spray	Effective for instant hand disinfection	US Patent No. 6,767,876
Floor Disinfectants				
6.	Swabee	Antimicrobial floor disinfectant	Effective against most pathogenic microbes	US Patent No. 6,767,876
7.	Flomop	Insect repellent floor disinfectant	Repels most house hold insects	CIMAP know how
Nutraceuticals				
8.	CIM-Paushak	*Rasayana*-based *awaleh* acts as immunomodulator	Improves metabolism	CIMAP know how
9.	CIM-Phal Se	Nutritive granules taken orally as chewable food value supplement	Antioxidant rich in natural source of vitamin C, trace minerals and carbohydrates	CIMAP know how
Hair Care				
10.	Geranium Active	Geranium-based anti-dandruff shampoo	Controls dandruff	CIMAP know how
11.	Herby Soft	Herb-based shampoo	Natural cleansing and conditioning of hair	CIMAP know how
Oral Care				
12.	CIMAP Mouthwash	For healthy teeth and gums	Clinically proven anti-caries and long lasting mouth freshener	CIMAP know how
Mosquito Repellents				
13.	Mospray	Mosquito repellent spray	Effective against mosquitoes and room freshener	Indian Patent No. 186120
14.	MosEx	Mosquito repellent lotion	Effective against mosquitoes and skin softener	Indian Patent No. 185784
15.	MosRep	Mosquito repellent *Agarbatti* (incense stick)	Effective against mosquitoes	Patented in China No. ZL00801425.6
16.	Mosnobite	Mosquito repellent vaporizer	Effective against mosquitoes	Patent filed in India No. 226NF, 2005
17.	Mosaway	Mosquito repellent cream	Effective against mosquitoes	CIMAP know how
Other				
18.	Pain Chhoo…	Pain balm	Effective in headache, muscular sprains and cold	CIMAP know how

3. ICAR Initiatives

The Indian Council of Agricultural Research (ICAR) is an autonomous organisation under the Department of Agricultural Research and Education, Ministry of Agriculture, Government of India. It has 97 institutes, 46 state agricultural universities, five deemed universities, one Central Agricultural University and 589 *Krishi Vigyan Kendras* (KVKs) spread across the country making it one of the largest national agricultural systems in the world (ICAR Vision 2030, 2011; ICAR, 2011). It has played a key role in

the Green Revolution and subsequent agricultural improvements in India through its R&D that has enabled the country to increase the production of food grains 4 fold, horticultural crops 6 fold, fish 9 fold (marine 5 fold and inland 17 fold), milk 6 fold and eggs 27 fold since 1950-51, thereby making a visible impact on the national food and nutritional security. It launched the *Lab-to-Land* program and the National Agricultural Research Project (NARP) in 1979 as well as *Institution-Village Linkage Program* (IVLP) in 1995. Later it launched National Agricultural Technology Project (NATP) in 1998 and National Agricultural Innovation Project (NAIP) in 2005.

Indian agriculture is dominated by small farmers, having small landholdings. The average size of the landholding declined from 2.30 hectare in 1970-71 to 1.32 hectare in 2000-01 with the absolute number of operational holdings increasing from about 70 million to 121 million, respectively. Going by this trend, the average size of holding in India would be mere 0.68 hectare in 2020, and may further decline to a low of 0.32 hectare in 2030. To add to small landholder's problem, the quality of production environment is worsening. The green-revolution belt is presently exhibiting second-generation problems due to over-exploitation and mismanagement of soil-and-water resources (ICAR Vision 2030, 2011). Similarly, it has been estimated that the demand for food grains would go up from 192 million tonnes in 2000 to 345 million tonnes in 2030. Till date, the agri-marketing sector in India has been unorganized and inefficient with 18 - 25% losses in the entire supply-chain. The major challenge for the future of the Indian agriculture is to evolve effective mechanisms for linking front-end activities of agricultural supply-chain (wholesale, processing, logistics and retailing) with its back-end activities of farm production that would lead to increased efficiencies, ensured remunerative prices to farmers, assured markets and reduced production and market risks (ICAR Vision 2030, 2011; Rao, 2010). There are plenty of opportunities for strong public-private partnerships (PPPs) in the agricultural R&D as well as for fostering relevant agro-entrepreneurship and techno-incubators. In the past the research contribution of ICAR has been significantly higher as compared to its counterpart in other countries. Empirically it could be seen that investment in agricultural R&D was a win-win option and contributed significantly in reducing rural and urban poverty (NAAS, 2009). The average internal rate of return on investment (ROI) in agricultural research was ~ 46% during 1980/81 and 2006/07, which is comparable to international standards (Chand et al., 2011). Some of the benefits of the robust R&D growth provided by ICAR initiatives have been shared by the smallholders during the unfavorable production environment (Pal et al., 2005). To accomplish its vision and the mission highest priority is laid on farmers, and entire strategy is based on a '*farmer first*' mantra. ICAR plans to tackle these challenges through innovative R&D approaches, which will ultimately prove a boon for the weaker farmers. Some of these are as follows: (i) harnessing the potential of genetic resource enrichment and biotechnology, (ii) precision agriculture (iii) synergies of frontier sciences, (iv) agricultural diversification, (v) post-harvest and value addition, (vi) management of energy and agriculture waste, (vii) bio-risk management, (viii) institutional policies, (ix) human resource development, and (x) technology transfer systems. It is believed that agricultural R&D would augment farmers' income, generate employment opportunities, conserve natural resources, restrict imports, promote exports and increase value-addition for higher and inclusive agricultural growth. Towards this end, in future, ICAR plans to be more sensitive to the needs of the farming community, especially of the smallholders and of the poorest of the poor living in the backward, fragile and marginal areas and will focus more on the products and the areas where private sector is reluctant to venture.

4. Societal Development through Biotechnology – DBT Efforts

DBT's biotechnology-based program for Indian society has three components targeted at women, scheduled caste/scheduled tribe (SC/ST) population and the rural community. Till date it has benefited over 53,000 families through application of biotechnology. The major areas through which DBT supports the beneficiaries are bio-pesticides, bio-fertilizer application, organic farming, cultivation of mushrooms, MAPs, sericulture, processed food, floriculture, etc. (DBT, 2011). Besides, the program has also provided health counseling to people (~ 19,000) suffering from genetic disorders. DBT has also carried out special programs for the relief of earthquake victims (at Latur, Uttarkashi and Bhuj).

4.1. Program for Women

Women trained for entrepreneurship on floriculture, vermi-composting, fruit processing, food technology, poultry rearing have set up their own units and are earning handsome incomes. A Golden Jubilee Biotechnology Park (registered under the Societies Registration Act and located in Siruseri, spreading over twenty acres of land) for women has been established as a part of the Golden Jubilee Celebration of India's Independence. It is a joint project with the Tamil Nadu State Government and aims to provide opportunities for professionally qualified women to develop a career of remunerative self-employment through eco-friendly

biotechnological enterprises. There are 20 industrial modules and 40 land modules for agro-biotechnology activities apart from centralized facilities for technology resourcing, training, testing and marketing. Twelve of the 20 pre-built industrial modules were allotted to women entrepreneurs on lease basis, for initiating their production activities related to ornamental fish, herbal products, fortified salts and food products. Seven of them started production and commercialization of herbal cosmetics, bio-fertilizers and bio-pesticides and fortified (with herbs, greens and essential oils) spice powders. The park has also established a herbal garden (as a live gene bank) and a database (to help the prospective entrepreneurs to identify viable projects) (DBT, 2011).

4.2. For SC/ST Population

The SC/ST population of the Peermade Development Society, Idukki District, Kerala, have been aided for improving their economy through a project on cultivation of tissue culture vanilla. Similarly a project on fortifying health care practices and conservation of medicinal and nutritious plants was initiated at Herbal Folklore Research Centre, Tirupati for implementation in 100 villages of two mandals in Andhra Pradesh and another project was undertaken on cultivation of *Jatropha* in dry lands of Namakkal district in Tamil Nadu for production of bio-fuel and other products as an income generation activity for the SC population at Centre for Research in Social Sciences, Coimbatore. In another instance, a project on development and practice of vermiculture as an effective source of bio-fertilizer for improved agricultural productivity among the scheduled castes of Veerapandi Block of Salem district in Tamil Nadu was implemented at GRD Educational Trust, Coimbatore. A project on production and application of neem and other plant based bio-pesticides for insect control was implemented at Madurai Kamraj University, Madurai. Another project on agro-ecological conservation was implemented at *Krishi Vigyan Kendra*, Pravara Institute of Research and Education in Natural and Social Sciences (PIRENS), Babhaleshwar in Ahmadnagar District, Maharashtra. In the project, SC/ST families were selected to undertake training, demonstration and trials of different biocontrol agents of pests and diseases (*Helicoverpa armigera* Nuclear Polyhedrosis Virus [HaNPV], *Nomuraea* spp., *Trichoderma* spp., *Paecilomyces* spp. and *Verticillium* spp.) on various crops and were enabled to earn a decent income. A project on mushroom cultivation was implemented at Madurai Kamaraj University for the unemployed SC/ST youth in Madurai and Virudhunagar Districts. Many projects related to aquaculture have also been implemented for benefit of SC/ST population, as for example, (i) murrel (a freshwater fish having low fat, few intramuscular spines and survival in oxygen-depleted waters and also fetching high price) culture and seed production undertaken at Centre For Aquaculture Research and Extension (CARE), Palayamkottai, Tamil Nadu (SC/ST youth were trained on identification of murrel species, sexual dimorphism, induced breeding technique, seed production and larviculture, live feed culture involving artemia and rotifers, monoculture and polyculture of murrel with catfish and disease management.), (ii) integrated fish-duck farming at Kalyani University, (iii) fish-duck integrated aqua-farming and dissemination of organic recycling for the benefit of SC/ST and weaker section of Tarai region of Uttaranchal by GB Pant University of Agriculture and Technology, Pantnagar, (iv) integration of fish, duck and horticulture farming was taken up by Indira Gandhi Agricultural University, Raipur in the village tanks of Chhattisgarh for improving fish production and poverty alleviation (DBT, 2011).

4.3. For Rural Community

More than 25,000 rural people have been trained in various areas such as wasteland utilization, vermiculture and vermi-composting, food technology, sericulture, mushroom cultivation, floriculture, bio-fertilizer, aqua-farming, poultry farming, rabbit rearing for quality wool production, medicinal and aromatic plant cultivation and formulation of herbal medicines (DBT, 2011). A model biovillage project was set up in Gujarat at Mocha, whereby a drinking water plant has been installed to make available 30,000 litre of drinking water per day. Another biovillage project has been supported through Science and Technology (S&T) Council of M.P. in 10 villages in 5 districts of the state. The biovillage project supported at Shahjahanpur, U.P., was for training beneficiaries for sugarcane cultivation. A concept has been developed to establish Rural Bioresource Complex (RBC) for demonstrating viable and ecologically compatible technologies to the rural population for adoption in a holistic and sustainable manner. The first phase projects for this have been funded at four state agricultural universities (Marathwada Agricultural University, GB Pant University of Agriculture and Technology, University of Agricultural Sciences, Bangalore and Haryana Agricultural University, Hissar).

5. Science for Equity Empowerment and Development (SEED) by DST

The SEED program of DST has the broad objective of providing opportunities to motivated scientists and field level workers to take up action-oriented and location-specific projects aiming towards socio-economic upliftment of poor and disadvantaged sections of the society through appropriate S&T interventions especially in the rural areas. Under this program efforts have been made to associate concerned

national labs or other specialist S&T institutions with each major program so as to build-in expert input, utilize national S&T infrastructure and link it up with grassroots S&T interventions/initiatives (DST, 2011). The major achievements under the SEED program have been as follows:

(i) Long term support to strengthen S&T-based voluntary groups as *centers of excellence* in rural areas

(ii) Rural and women technology parks

(iii) Integrated village development

(iv) Technology Interventions for Elderly (TIE)

(v) S&T interventions involving Jawahar Navodaya Vidyalayas (JNVs)

(vi) Technology Intervention for Mountain Eco-systems (TIME) program for alternative livelihoods in mountain areas including North East

(vii) Coordinated programs at different geographical locations

a) Medicinal plants cultivation and processing to benefit SC/ST community

b) Dissemination of state of the art technologies in sericulture for SC/ST communities

c) Program on improved fodder cultivation to involve and benefit rural women

d) Bio-Integrated Organic Farm Management (BIOFARM) to benefit small and marginal farmers

e) Coordinated Program on Non-Edible Oils (AICRP-NEO) for gainful utilization of Non-Edible Oil (NEO) bearing plants under diverse field conditions.

6. ASTRA/CST

The mission that was started in 1974 in the form of the Centre for ASTRA (Application of Science and Technology for Rural Areas) by the Indian Institute of Science (IISc) is still continuing (now known as Centre for Sustainable Technologies [CST]). It is IISc's inter-disciplinary research and technology development centre for providing sustainable solutions to host of global concerns, primarily dealing with energy, buildings and environment (ASTRA, 2011). CST has successfully worked in the area of energy efficient wood burning devices, biomethanation, biomass gasification, alternative building technologies, green buildings and building-integrated photovoltaics (BiPV), water purification and defluoridation, sanitation, sustainable biomass for energy, forestry, bioenergy and climate change, and environmental quality assurance-impact studies. The range and impact of CST technologies over the past three decades have been noteworthy - 1.5 million rural households are using the ASTRA wood burning devices for their cooking needs, adoption of biomass gasifiers for village electrification and industries is resulting in daily savings of about 30 tonnes of fossil fuel, thirty-five biomethanation plants are converting bio-waste into useful biogas and about 12,000 buildings (including 5000 in earthquake affected regions of Gujarat) have been built using alternate building materials developed at CST. Technologies for defluoridation of water and appropriate tsunami-resistant sanitation systems designed and developed by CST have been gaining popularity in the country. Major strides have also been achieved in designing policies for climate change at the national and global level. On the futuristic front, CST is planning to develop technologies for carbon sequestering, nanotechnology-based water treatment devices, bio-fuels, nitrogen-recovery from contaminated surface and groundwater resources, biomass refineries for gas (producer gas, hydrogen, etc), liquid fuels and byproducts, energy generation from waste, low-carbon buildings and climate-change mitigation (ASTRA, 2011).

7. Conclusion

The role of S&T in transforming rural India has been well established since the pre-independence days. As early as 1935, at the All India Village Industries Association, Mahatma Gandhi initiated a movement called 'Science for People', with an advisory board of national personalities including scientists like J. C. Bose, P. C. Ray and C. V. Raman (Reddy, 2004). The only change in recent years is that newer modes of technology like the information and communication technologies (ICTs) have been widely used in alleviating poverty in rural communities and empowering them. The computerized milk collection centers, enhanced access to government services (*Gyandoot*) and improved access to microfinance through smart cards have led to greater transparency, which in turn enabled empowerment of poor (Cecchini and Scott, 2003). However, achieving low cost connectivity is the most important prerequisite as well as challenge for success of any ICT-based project, more so in rural context. The Information Village Research Project of M.S. Swaminathan Research Foundation (MSSRF), Chennai attracted the attention of the world and won the Stockholm Challenge Award and the Motorola Dispatch Solution Gold Award (Arunachalam, 2004).

Poverty alleviation programs of the government in the post-economic reform era have been reviewed by Yesudian (2007) to evaluate their contribution towards reducing poverty in the country. They could be classified into (i) self-employment programs; (ii) wage employment programs; (iii) food security programs; (iv) social security programs; and (v) urban

poverty alleviation programs (Yesudian, 2007). However, it must be kept in mind that poverty alleviation is not confined to alleviating economic poverty. Rather it must lead to socio-economic upliftment in terms of empowerment, access to services and freedom to decide one's fate. It can be safely said that the use of modern technology underpins the various types of poverty alleviation programs run by the Government and increases the probability of their success in a holistic manner. This phenomenon is evident from the success stories of the initiatives outlined in this review study. Technology also adds newer paradigms for identification of root causes for poverty and devising equitable delivery systems for their alleviation. As an example, nationwide wasteland mapping project, carried out by National Remote Sensing Agency, has provided insights into the problems related to natural resources degradation and a strategy for rural poverty alleviation in India (Srivastava et al., 2004). As another example, alternative approaches for delivery of medical technology for rural health have also been developed (Antia, 2004). Many a times, technologies fail to leave an impact on their target audience due to lacunae in their generation, diffusion, adoption as well as due to their poor documentation (Gangopadhyay et al., 2009).

Table 2. Glimpses of major Indian R&D agencies and their salient roles in poverty alleviation. (The list in this table is not all exhaustive. It is only exemplary.) (Ref. Websites of various R&D agencies cited in the reference list)

Agency	Major Role	Novel Strategies	Examples of Achievements
CSIR	Pan-India agency having a network of 38 national laboratories spanning a wide spectrum of science and technology	It provides cutting edge technological intervention in diverse areas with regard to societal efforts for health, housing, food, drinking water, energy, farm and non-farm sectors, environment; *Biovillage Missions*; *Kisan Melas*; *Sakshama*; Traditional Knowledge Digital Library; CSIR800	Strong patent portfolio; Products like Amul baby food, Nutan stove, Saheli - a non-steroidal once-a-week oral contraceptive pill for women, E-mal for malaria control, Asmon - a herbal therapeutic for asthma, SARAS - a multi-role aircraft, Flosolver India's first parallel computer, Swaraj and Sonalika tractors, the indelible ink used during elections, Soleckshaw - a solar electric rickshaw or pedicab, etc.
ICAR	Pan-India agency having a network of around 100 national agriculture-related institutes	Green (Food grains), Yellow (Oil seeds), Blue (Fisheries), Golden (Horticulture) and White (Milk/Dairy) Revolutions; *Lab-to-Land* program and the National Agricultural Research Project (NARP); *Institution-Village Linkage Program* (IVLP); National Agricultural Technology Project (NATP); National Agricultural Innovation Project (NAIP)	National Gene Bank; Increased productivity of food grains and other crops; Development of varieties/hybrids of crops; DUS (Distinctiveness, Uniformity and Stability) testing parameters for crops; National Animal Disease Referral Expert System (NADRES); Ghungroo Pig - a potential strain of indigenous pig for the rural farmers; Vaccine for sheep and goat plague; Backyard poultry farming of Vanaraja breed - a less capital enterprise; Athulya (ILM-1990) layer chickens; Revival of Krishna Valley cattle breed; Jayanti rohu - multiple breeding in carps for year round fish seed availability; Database 'Fish Chromosome World'; DNA barcoding of fishes; Trained over 1.0 million farmers/extension personnel
ICMR	Apex body in India for the formulation, coordination and promotion of biomedical research	Control and management of communicable diseases, fertility control, maternal and child health, control of nutritional disorders, developing alternative strategies for health care delivery, containment within safety limits of environmental and occupational health problems; Health initiatives for tribal populations	Diagnostics for diseases; Intra-uterine contraceptive device Cu T 380 A demonstrated its long term efficacy and acceptability and has been introduced in the National Family Welfare Program
DBT	Implementation and strategy building for biotechnology at national level; Nodal point for the collection and dissemination of information relating to biotechnology	Targets attainment of newer heights in biotechnology research, shaping the discipline into a precision tool for wealth creation and ensuring social justice – focused on poverty alleviation; Specialized programs for women, scheduled caste/scheduled tribe population, and rural community	Bio-pesticides and bio-fertilizers; Fortified Wheat Flour and Rice Premix for school going children; Mineral Vitamin Mix for malnourished children; BIBZinC® - zinc dispersible tablets for diarrhoea management; ROTAVAC® - low cost rotavirus vaccine; Other vaccines have also been developed or are underway; Baculovirus resistant/tolerant silkworm
DST	Promoting Science & Technology (S&T); Nodal department for organising, coordinating and promoting S&T activities in the country	Application of S&T for weaker sections, women and other disadvantaged sections of society; Science for Equity Empowerment and Development (SEED) program	Rural and Women Technology Parks; Soil Testing Kit; Synthetic and Art Silk Mills' Research Association (SASMIRA) membrane filtration system for textile industry to reduce pollution by recycling

The most significant finding is that technology can enhance poverty alleviation initiatives more potently, if it is locally driven and appropriately suited to community needs, as particularly evident in the case of MAP-based missions.

Going by the current trends, it can be clearly predicted that in the times to come, R&D institutes of the nation will continue to play a major role in empowering the weaker sections of society. The only thing that they need to focus is that they should employ community involvement and local ownership of developed applications.

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Highlights

- India has a rich scientific base and is marching ahead as a knowledge-based economy.
- It has established several government-funded R&D institutions.
- Their mandates aim towards empowerment of weaker sections of society.
- Some of the technologies have made a significant impact on societal development.
- This paper discusses some such case studies from these R&D institutions

Abbreviations

ICAR: Indian Council of Agricultural Research; CSIR: Council of Scientific and Industrial Research; ICMR: Indian Council of Medical Research; DBT: Department of Biotechnology; DST: Department of Science and Technology; CIMAP: Central Institute of Medicinal and Aromatic Plants; MAP: Medicinal and Aromatic Plant; R&D: Research and Development; S&T: Science and Technology.

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