

**Executive Summary of the report of the Working
Group on
S&T for the Vulnerable Sections of Society:**



**Ministry of Earth Sciences
September, 2011**

Report of the Working Group on S & T for Vulnerable Sections of Society

1. Introduction:

Working groups on S & T for Vulnerable Sections of Society was constituted by the Planning Commission vide O. M. No. 12016/3/2011-S&T dated April 18, 2011 under the Chairmanship of Dr. Shailesh Naik, Secretary, Ministry of Earth Sciences. The composition and terms of reference of the Working Group are given at Annexure I.

The working group had two meetings on 18th May, 2011 and July 20, 2011 in the office of Secretary, Ministry of Earth Sciences at Mahasagar Bhawan, CGO Complex, Lodhi Road, New Delhi.

The first meeting of the Working Group was held on 18th May, 2011 and was attended by Dr. Shailesh Nayak, Secretary, MoES, Delhi; Dr. P G Rao, NEIST, Assam; Prof. A. Jhunjhunwala, Professor, IIT, Chennai; Prof. Anil Gupta, IIM, Ahmedabad; Dr. George John, Advisor, DBT, Delhi; Dr. R. S. Deshpande, Director, ISEC, Bangalore; Dr. Vinita Sharma, Advisor, DST, Delhi; Dr. Parvinder Maini, Director, MoES, Delhi; Dr. Ashok Sonkusare, Deputy Advisor, Planning Commission, Delhi and Shri Sunil K. Agarwal, Scientist D, DST, Delhi. Some key issues related to vulnerable population were discussed and members were requested to submit brief notes on some of these issues.

The second meeting of the Working Group was held on July 20, 2011 and was attended by Dr. Shailesh Nayak, Secretary, MoES, Delhi; Dr. P. K. Ghosh, Director, CSMCRI, Bhavnagar; Dr. R. S. Deshpande, Director, ISEC, Bangalore; Dr. D. Bhardwaj, Joint Advisor, Planning Commission, Delhi; Dr. Vinita Sharma, Advisor, DST, Delhi; Dr. Parvinder Maini, Director, MoES, Delhi; and Shri Sunil K. Agarwal, Scientist D, DST, Delhi. The suggestion/comments/inputs submitted by the members were discussed and outlines of possible recommendations to be made were agreed upon. It was also agreed that first draft of the Working Group would be prepared and circulated for comments and observations and thereafter report may be finalized by the Chairman for submission to the planning commission.

2. Background:

Certain groups in the society often encounter discriminatory treatment and need special attention to avoid potential exploitation. This population constitutes what is referred to as **Vulnerable Groups**. Vulnerable groups are disadvantaged as compared to others mainly on account of their reduced access to basic services and the underlying determinants of health such as safe and potable drinking water, nutrition, housing, sanitation etc. The vulnerable groups that face discrimination in all spheres of life include Women, Scheduled Castes (SC), Scheduled Tribes (ST), Children, Aged, Disabled, Poor migrants, People living with HIV/AIDS and Sexual Minorities. Sometimes

each group faces multiple barriers due to their multiple identities. For example, in a patriarchal society, disabled women face double discrimination of being a women and being disabled. This can be attributed to physical, mental as well as their financial attributes. Children and the elderly population face different kind of vulnerability. Mortality and morbidity among children are caused and compounded by poverty, their sex and caste position in society. All these have consequences on their nutrition intake, access to healthcare, environment and education. These factors directly impacts food security, education of parents and their access to correct health information and access to health care facilities. Some of the factors which impact and lead to further vulnerability are:

Poverty: Due to their vulnerability, social groups are characterized by levels of poverty that are higher than the average levels of poverty among the population. As vulnerable groups are deprived and marginalized and poor, their poverty in turn exacerbates their deprivation and marginalization leading to a vicious circle that perpetuates their poverty. Science and Technology inputs can help to break this vicious circle and thus allow the vulnerable social groups to enter into a virtuous circle that can allow them to escape the trap of absolute and extreme poverty.

Limited Access to Energy Services: One of the most crucial characteristics of vulnerable households is lack of access to energy. Appropriate Science and Technology (S & T) interventions can allow the vulnerable communities and social groups access to energy especially decentralized options. This in turn will allow them to increase their productivity and thus their incomes, as well as allow access to social services such as education that in the long run can enable the vulnerable communities to escape the poverty and income trap. Additionally, appropriate S & T inputs can allow the vulnerable to increase the productivity of their labour as well as assets, thereby improving their incomes and savings.

Biodiversity Loss and Environmental degradation: Most vulnerable groups depend on natural resources for their sustenance. Over exploitation and development pressures often erode these resources making these communities (ST) more vulnerable and threatened leading toward livelihood insecurity.

Climate Change: The impacts of climate change will fall disproportionately on the vulnerable due to their dependence on natural systems for their livelihoods, which will lose their productive capacities in the absence of appropriate scientific and technological interventions. S & T inputs will be needed for both vulnerable communities' and ecosystems adaptation. In addition, S & T application can allow the vulnerable communities to participate in and benefit from developmental co-benefits of climate change mitigation efforts.

Lack of Equity and Inclusiveness: Inclusiveness is based on the principle that benefits of any society or government schemes must be available to all regardless of caste, class or background. However, this is often not the case as most benefits cannot be accessed by the vulnerable communities. Inclusion, accessibility and equity are some of the key factors which each government intervention should aim

to deliver as that is what will ensure overall development and a well governed country.

Initiatives during 11th Plan Period

3. Govt. Of India Initiatives during 11th Plan Period

Certain officially identified social groups such as SC, ST, Women, Elderly PWD's are benefited by government programs and schemes which are driven by social and economic welfare concerns. Some schemes for empowerment of these vulnerable groups through input of S&T have also been initiated by the Government of India. The Government has brought in several legislations to protect and safeguard the interests of the deprived and the disadvantaged sections of society,. This includes Right of Children to free Education Act 2009, the Protection of Women from Domestic Violence Act, 2005, the Right to Information Act, 2005, the Commission for Protection of Child Rights Act, 2005, the Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forests Rights) Act, 2006 etc. In addition, several line Ministries& Scientific Ministries under Government of India have launched programs to empower vulnerable section of the Society.

Although Government of India has been taking several steps and measures for the upliftment of the vulnerable section of society through community based programme, right to education, empowerment of rights, infrastructure development, creation of job opportunities, yet the efforts are not often enough sustainable. A glimpse of the several schemes launched by Scientific Ministries under the Government of India is as under:

Ministry of Science & Technology: The Ministry of Science & Technology has several schemes to catalyze and support research, development and adaptation of relevant and appropriate technologies for empowering and improving quality of life in rural areas. The schemes are being implemented by Department of Science & Technology, Department of Scientific and Industrial Research, and Department of Biotechnology. CSIR laboratories are also involved in technology development for rural empowerment. Under this initiative, flagship programmes are being implemented to benefit and empower community at the grassroots level with innovative technological interventions and services for improved livelihoods. Focus under such societal programme is to create new and potential models to facilitate employment opportunities at grassroots level and enhancement of income and quality of life. Emphasis is also being given to provide technological solutions to location-specific problems through technology modulation, field testing and transfer.

Technology institutions / R&D laboratories function as a source of relevant technologies and models which are implemented in rural areas through voluntary agencies and other institutions. The impact of the programmes has been felt in local areas. Under the Societal initiatives of the Department of Science and Technology, many field tested models and local level technologies have been developed and are being practiced to meet the need of vulnerable sections in rural/urban areas. Some of the indicative technologies/packages are –

Technologies for livelihood generation:

- Fruit/vegetable processing and preservation for value addition at village level with quality control.

- Drier for coconut gratings; paper and biomass based drier for horticulture produce.
- Technology package for low-temperature glazing for making red clay pottery developed and many units are in operation especially in Kanyakumari area.
- Biogas plants using spoilt grains, fruits, etc. for small restaurants/dhobis. 500 units have been installed in Maharashtra.
- Standardization of tissue culture techniques for producing disease free banana in Sundarban delta by trained women group.

Technologies for Improved Quality of Life:

- Technology for low-cost sanitary napkins.
- Low-cost diagnostic medical kits for urinary tract infections.
- Setting up of Women/Rural Technology Parks as integrated model for technology dissemination.
- Non pressurized Sarai cooker which takes 40 minutes for complete cooking. This is under commercial production
- Upgradation of watermills with multipurpose use for generating electricity.
- Research directed towards poverty driven diseases such as tuberculosis, leprosy, malaria, *filariasis* and visceral *leishmaniasis*.
- Ultra membrane Water filters.
- Technology based sustainable livelihood of tribals around protected area/national parks in partnership with local voluntary organizations and WWF-India.
- Resource management and use of simple technologies for scheduled caste population in hilly, southern and central India
- Rural Energy Programme linked with Micro-Enterprise Development in 10 Non-Grid remote Villages.
- Programme for Elderly: Web portal for technologies related to elderly persons, designs of houses, and assistive devices, nutritional aspects etc.; scholarships for design innovations; mobile pilot unit for health care.

Ministry of Earth Sciences (MoES): MoES was formed in 2006 and although the Ministry had no such mandate in the 11th plan to launch dedicated schemes for the underprivileged, yet it has a clear mandate to provide accurate weather and climate services, island development programmes etc. Although the weather and climate services affect one and all equally, yet it is this section of the society who are more susceptible to these disastrous events as they are both economically and financially weak. Ministry has been providing weather/climate related service on land and ocean through its various constituent units namely India Meteorological Department (IMD), Delhi; National Centre for Medium Range Weather Forecasting (NCMRWF), NOIDA and Indian National Center for Ocean Information Services (INCOIS), Hyderabad. In addition, the National Institute of Ocean Technology (NIOT), Chennai, under the programme Ocean Science and Technology for Islands (OSTI) is involved in development of Ocean Technology by tapping the ocean resources for improving the

socio-economic status of the island and coastal communities. This includes the establishment of Desalination Plant at Kavaratti, breeding, rearing, and fattening of Lobster and mud crab for the benefit of island and coastal community. Center for Marine Living Resources & Ecology (CMLRE) which promotes Ocean Development activities is involved in the breeding of ornamental fish for production of pearls from the black-lip pearl oyster. The people living in the shores are particularly susceptible to changing climate. NIOT under the Ministry is developing technology for Shore Protection through environmentally friendly solutions.

Ministry of Women and Child Development: The Ministry has specific schemes for the holistic development of the child through several schemes on nutrition, immunization, health check up and referral services, pre-school non-formal education. The Ministry also has several schemes for the empowerment of women.

Ministry of Rural Development: This Ministry has several programmes which are aimed at poverty alleviation, employment generation, infrastructure development and social security for the rural poor especially those below the poverty line. The three departments under the Ministry are rural development, Land Reforms and Drinking Water which have several schemes for generating self-employment, land-reforms for better revenue generation and safe drinking water

Ministry of Labour: Works diligently for the upliftment of the SC/STs especially the unemployed by creating several job opportunities through self-employment schemes.

Ministry of Social Justice & Empowerment: The Ministry has several schemes for empowerment of the disadvantaged and marginalized sections of the society namely, Scheduled Castes, Backward Classes, Persons with disabilities, Aged Persons and Victims of alcoholism and drug abuse through educational, economic and social development.

Ministry of Tribal Affairs: The Ministry of Tribal Affairs constituted in 1999 has a mandate of providing schemes for the socio-economic development of the most under-privileged sections of the Indian society namely, the Scheduled Tribes (STs), in a coordinated and planned manner. It is the nodal Ministry for the overall policy, planning and coordination of programmes for development of STs and has launched several programmes for the upliftment of STs.

Perspectives for 12th FYP

4. Perspectives for the 12th Five Year Plan (2012-2017):

In order that the vulnerable sections of society have equal opportunities self-sustained life which safeguards their interest against the changing economy and other environmental issues, this working group was formed by the Planning Commission to suggest special S & T intervention programmes directed towards the up-liftment of the deprived and weaker sections of society including women, SC/ST, People with disabilities elderly and people living in geographically difficult places. The Working group deliberated and noted that there is a dire need to address vulnerability issues by each scientific ministry in their respective areas of work focusing on improved quality of life. There is a need to develop and bring into practice innovative approaches on improving services for vulnerable populations. It requires preparation of vulnerable communities' action plan with institutional arrangement and capacity building for implementation during 12th plan period to enhance effectiveness in service delivery for vulnerable groups.

4.1 Approaches and Probable areas of S & T innovation: All the initiatives taken thus far are more focused on social up-liftment of the society, but with the challenge of the environmental changes and livelihood security looming large in the background, efforts should be directed towards creating opportunities for sustainable development of the society at large. The women, children, underprivileged, SC/ST and elderly are more vulnerable as they have few resources and few choices and have little adaptive capacity. According to UNDP (2010) publication for designing and implementing gender-sensitive community-based adaptation programmes and projects - limited access to resources, restricted rights, limited mobility and voice in community and household decision-making can make the women much more vulnerable than men to the effects of climate change. We have to therefore focus on innovative S & T programmes directed towards addressing the basic day-to-day needs of the people through development of schemes/programmes that increase the adaptive capacity and resilience to emerging global problem of livelihood as well as food security. This also involves conservation issues of the natural resources. To do this we have to first identify emerging issues and approaches for sustainable development. Today the entire world is facing the challenge of increased degradation of forest and land ecosystem, biodiversity loss, climate change and the associated variability in weather and climatic patterns, depleting drinking water availability, increasing energy prices etc. All these come in the way of our economy. Thus, for an accelerated growth of our economy, we have to initiate R & D support and effective technology delivery mechanisms in areas of sustainable livelihood, better productivity and improved resource conservation. Therefore, we need to build innovative schemes/programs that address these above issues.

4.2 Need: S&T based Solution Programmes for Vulnerable Sections of Society: Societal Intervention of S & T is an emerging field of action research that holds promise for the future of our country. This field builds on interactions among humans, their technologies, and the environment, and on the use of such knowledge to advance sustainability goals towards equity to address problems

related to water, food, energy, health, habitat, mobility, and environment services. Therefore, S & T based innovative technology development and delivery programmes for the 12th plan period to be formulated especially for the vulnerable section of society basically around sustainability science to involve and empower such disadvantaged sections of the society with new/improved skills and knowledge for livelihood security.

Therefore by using appropriate management techniques and innovative scientific tools and techniques, the resources will be used in a more effective manner for sustainable development through collective cooperation between different stakeholders which includes government functionaries, industry, academia and the society at large. It requires building specific S & T programmes that involve the collective wisdom of all sections of society. Key aspirations of the stakeholders in present context are:

- **Strengthening human capacities**

- ❖ Promote Individual inputs towards R&D to address issues for vulnerable sections
- ❖ Promote individual innovations to solve grass root problems
- ❖ Involve larger number of scientists in technology adaptation and transfer programmes

- **Strengthening Institutional capacities**

- ❖ State S&T councils as tools for technology absorption and deployment.
- ❖ Strengthening of S& T capability of S&T in rural areas.
- ❖ Networking of institutions based in rural areas
- ❖ S&T at the Panchayati Raj Institutions

- **Technology Development and Deployment**

- ❖ Strengthening initiatives in technologies for fertilizers, solar energy etc.
- ❖ 'Oriented fundamental research' to solve problems like TB, water, energy, etc. and a special drive for promotion of drug discovery

Thus, the S & T based solution programmes/areas for capacity building (both institution and human capacities) and sustainable development that need to be actively considered for development of vulnerable sections of the society are:

- a. Clean and Renewable energy / gadgets; Solar and wind energy; micro-hydel power for decentralized generation and utilization of power involving community.
- b. Water Security: Cost effective technologies for Recycling and purification - potable water management.
- c. Agriculture & Food Security: Sustainable agriculture and value addition; Agro-biotechnology tools for soil-water management, improved crop productivity, reduce soil salinity.

- d. Affordable Health care & Health security - Adaptation and resilience; vector control services; Drugs/Pharmaceuticals. Promote capacity-building among health professionals to ensure conformity with the right to health in service delivery. Green architecture – Energy-efficient building.
- e. Reducing carbon footprint; adopting green environment.
- f. Waste management: recycling.
- g. Coastal management S & T programmes.
- h. Sustainable transportation/mobility – Green fuel.
- i. Some of the areas that need immediate attention in the wake of changing climate are Sea-level rise, Soil-erosion, Extreme weather conditions including wet & dry spells, Heat wave/cold wave conditions, Forest Fires, Drinking water.

The points which were highlighted by the working group to be taken into consideration while planning these initiatives for the vulnerable sections were:

- The working group felt that in 12th plan there is need for bold initiatives, new models and inclusive engagement with the vulnerable sections of the society.
- A separate budget provision should be made as special purpose vehicle in the 12th Plan for the task towards addressing problems of vulnerable population through S & T interventions. The government may also consider setting up a social venture fund should be created for the tribal population.
- It is imperative that initiatives for vulnerable sections should be planned in consultation with social scientists & the communities involved.
- World over the focus is now on sustainable science and sustainability issues should be taken into account while planning initiatives.
- There is a need to work with a bottom up approach for tinkering traditional technologies to reach vulnerable population in the country so that the gap between technology offered and perceptions of people along with technophobia and inertia can be addressed.
- S&T interventions should be rooted in rural areas user friendly.
- The focus in this plan should be to list specific problems encountered in the occupational realm, inventorize them and address them with technology solutions.
- Engagement with youth in developmental activities has been rather poor and the need of the hour is to challenge the youth with solution science and also ignite their potential for innovation.
- There are over 1 lakh Post offices and the over 500 Krishi Vigyan Kendra having a pan India spread. Their services are presently underutilized and can be used for diffusion of technology.
- Climate change is an important area which needs immediate attention in the wake of changing climate, soil-erosion, extreme weather conditions, forest fires impacting livelihoods of the targeted communities like SCs and STs. Low cost low carbon resource management, initiatives for coastal fisherman, island development should be focused.
- The need of the hour is to provide sustainable Livelihood opportunities, affordable health care and energy solutions in rural areas so as to prevent

migration to urban areas. The successful technology based initiatives being taken by IIT, Chennai to include weather monitoring station and about 25 companies incubated in the manufacturing sector which are working primarily in rural settings should be replicated in other areas of the country.

- The Council of S & T for rural areas set by Department of Science & Technology needs to be strengthened and replicated in a large way.
- Need is to make rural S & T to be focused in larger programmes by involving different S & T Ministries & Departments. In this endeavor, focus should be to make substantial effort to take technology in enterprise mode with commercial viability.

The working group had a series of discussion and agreed that there is a need to make matrix of institutions initiatives, need for incentives, institutional arrangements, policy instruments required to plan and evolve effective programme on S & T for the vulnerable section of the society. Based on detailed discussion, working group formed following **sub-groups** to suggest strategies and critical areas/challenges to address major issues of vulnerable population through S & T intervention.

- I. Technological interventions to improve GDP of rural areas having acceptability at community level for livelihood gains.**
- II. Effective Technology Delivery Mechanisms/Models for vulnerable sections (SC, STs, Women).**
- III. Areas which are geographically/climatically vulnerable.**
- IV. Evolving workable technology models for Disability & Elderly.**

It was felt that to address above issues/areas of intervention, technology selection is a critical input to address the problems of vulnerable population and it should (i) benefit from it within their own situation; (ii) be based on local resources and local markets (iii) capable to remove drudgery (iv) enhance efficiency with minimum occupational hazards (v) empowers/enhances status/creates leisure for them (vi) provide flexibility to change with each situation- delivery, time frames (vii) adaptable and affordable.

Relevant inputs of the sub-groups are as under:

4.2.I. Technological interventions to improve GDP of rural areas having acceptability at community level for livelihood gains

Over the last couple decades, Indian economy has been growing rapidly. However, the growth-rates in urban India are much higher than that in rural India, with rural areas continue to grow slowly. World-over in post-industrial revolution era, rapid economic growth has always taken place in urban areas and rural areas have been depopulated. But India is different and the time is different. We cannot just follow the path that others did. As over 700 million people live in Rural India, this urban-rural dichotomy would result in serious problems and in a democratic country like India, could result in instability. Such large number of people would not move to urban India in any near future. There is no option but to strengthen rural economy. We need to figure out ways

to take rural India along with urban as our economy grow rapidly by expanding Rural livelihood opportunities.

One of the S&T priority areas should therefore be on how Rural GDP (in each district) could be enhanced. Today, the mainstay of rural GDP is still agriculture. However, agriculture contributes now to only about 16% of national GDP, even-though it may employ about 60% of the people. Naturally there is a heavy under-employment in agriculture, due to the fact that very little livelihood opportunities other than agriculture exists in villages. People, especially the younger ones, would move out of agriculture, if there were opportunities. In absence of this, many migrate to urban India, even-though living conditions in the urban slums that they migrate to is dismal. What is needed is therefore to create livelihood opportunities in rural India itself.

Potential Areas for expanding Rural livelihood Opportunities:

The first area of expanding livelihood could be **value-add in agriculture** itself. Agricultural output could be significantly enhanced even with known knowledge if agriculture farms are managed better. Proper selection of crops based on soil-conditions of the farm and market outlook would be the first task. Judiciously applying the agri- S & T inputs and following appropriate (Role of information / agri-extension) cropping techniques, new seeds, new variety would significantly enhance productivity. An equal focus has to be on countering, pest-attacks, which today causes huge crop-losses. Solutions are available, but they have to be used in timely manner. Irrigation and Water-harvesting, proper and sustainable use of water so that water-table does not deplete would be another area of importance for technological inputs. Further, the post-harvesting losses in India are known to be severe. Each of these requires appropriate S&T and management inputs at the level of an individual farmer. Add to it when to sell and where to sell one's produce (Organic farming, Forest / fisheries, Medicinal plants); the value-add can be very significant.

It is known that Agro-industries could employ a large number of people in rural India. **Decentralized food-processing industry** could flourish in rural India and make a significant impact on its economy. What is needed is the right technology to process, preserve and package in hygienic environments and creation of the right market channels. The industry (Agro-industry, food-processing, horticulture, oils) could either be independent industries (for example self-help groups) or could be micro-franchisee of a larger enterprise at the village and block level. Amul Dairy industry is an example of what could be done. Further agricultural by-products could be inputs for a number of endeavors. A flourishing agro-industry could employ significant number of people in rural India. Understanding what limits growth of such industries and de-shackling this would be an important task. Thus, rural industrialization offers a means by which to add value to rural produce within rural areas themselves, not only to generate rural employment and incomes, but also to redress the terms of trade between (rural) agriculture and (mostly urban) industry and increase the contribution of rural areas to the GDP by increasing their share within the industrial sector.

Looking at rapid development of depressed economies in 20th centuries in different parts of the world, one notices that the first phase of it started in East Asia. Whether it was Korea or Taiwan, and later on Philippines and Malaysia and still later China, the nations developed rapidly as manufacturing was out-sourced from West to these countries. The obvious reason was the large differential in labour cost. As soon as transport became less expensive, Western corporations preferred to shift their manufacturing industries to these countries. As the people in these countries barely had the skills, the initial outsourced manufacturing focused on routine and manual labour. But these nations used the opportunity to enhance their skills and the out-sourced manufacturing industries started carrying out more sophisticated tasks. Eventually, the nations in the far-east acquired enough expertise to manage and own their manufacturing industries and would supply the goods all over the world. They started investing in R&D and can now even own the designs and IPR for many of these products. While Korea and Taiwan today compete with the West in design and development, China has acquired the scale for becoming the supplier of goods to the whole world, but at the same time has also become technology leader in several sectors including telecom, power generation and transport systems.

Is it possible for Rural India to follow the same approach? Can urban India outsource some of its manufacturing to Rural India? It should be possible to do so in a sector which does not need heavy machinery and use less energy. In case some of the raw material comes from rural India, it would be an additional benefit. Fortunately road network now does connect most villages. If one can enable such **out-sourced manufacturing in decentralized manner to Rural India**, it could create significant employment in Rural India. For example, there could be industries which employ 40 to 50 people in 100 villages. Working close to home would be beneficial to rural folks. One could also have limited (say 5) hour employment, which would give additional income to a large number of women. Over time, it would mean higher confidence and enhancing abilities in rural India. One has to identify the bottlenecks for this to happen and figure out ways to overcome them.

The second phase of rapid economic growth in the 20th century took place in India, when IT enabled services started getting shifted from the West to India. Some computers and connectivity was all that was required. Educated youth in India could now get employed here itself rather than figuring out ways to go abroad. It started with routine work. But as the confidence and capabilities grew, more and more sophisticated work started getting done in India. Today, IT outsourcing to India has become large; its value exceeds USD 70 billion. The companies which carry out such outsourcing have become world-renowned. India is today the design house for the world.

Is it possible to use this approach now and have urban areas carry out their **IT enabled Services from rural India**? There is some connectivity, which is only likely to improve with time. Rural India has learned to manage and maintain computers. Enough examples exist where young people in rural India have geared themselves to learn fast, so as to deliver value on computers. Can one have a rural BPO in each village of India employing 40 to 100 people? One can begin with those who have acquired a higher secondary education and train them to carry out the required task. What would be

needed for such an industry to thrive? What are the bottlenecks and how can we overcome them? Rural BPO can indeed be large employer.

There has been some attention on development of Rural industry ever since independence. But, the industry is not growing as rapidly as one expected it too especially if raw-materials (Textile, bamboo, natural fibre) are from rural India. Understanding the reasons for them and overcoming them would be an important task. What are the issues and constraints? Do they require S&T inputs? Who do they market their products to?

Infrastructure required for Rural Industry to thrive: Whether it is Agro-industries, outsourced manufacturing industries, rural BPOs or any other rural industries, they all require certain infrastructure and support to flourish. The most important is reliable electrical power. Most rural areas today sparing get electrical power, even when they are connected to the grid. Power-cuts could be from 6 to 20 hours a day and could happen at any time any day. It all depends on what is being generated and what is being consumed in urban India. Rural India gets left-over power and therefore something totally not in its control. Further, even when they get power, the quality of power can be dismal. While under-voltage is the norm, shutting down most machinery, high-voltage and spikes may suddenly appear damaging the equipment. No kind of industry in rural India can flourish unless reliable quality power is available at some reasonable costs.

Equally important is road and communication infra-structure. Even though most villages now have tarred roads, the condition could often be quite dismal. Further public transport to carry people and goods is always questionable. Same is the situation with communications. The 2G mobile phone is now available most of the places. But data connectivity and Internet connection is still not available. Higher bit-rate data connectivity will indeed be a challenge.

Enabling Environment & Support Services required: Access to finance and financial services will be another serious issue. Banks still do not exist in villages and Banking Correspondent (BC) services are just taking off. Even where they exist, focus is on savings bank account and other services rather than loans. Similar challenges exist in terms of training and skill-development, required for an industry to thrive. Appropriate Entrepreneurship training would be required if one expects villagers to set up such industries. At the same time, one has not worked on policies and law governing rural enterprises and they are treated just like their urban counterparts. Therefore, even though minimum wages for full time employment would be advisable, issues like Provident Fund, Service Tax exemption and health insurance benefit need to be examined for a rural angle enabling rural enterprises to flourish even while protecting employees. Today the blind usage of urban-centred policies often damages such rural enterprises. Therefore, enabling environment for the growth of local institutions like self-help groups and linking them with banks need to be created. It is also observed that complete financial inclusion will be a kind of win-win situation where both the disadvantaged sections of the rural society and the primary banking agencies may economically benefit

One of the areas that need examination is the organization of **such manufacturing / services enterprises in rural areas**. Most rural enterprises face the challenge of marketing. How can this be overcome is a challenge.

If young educated people from rural India see livelihood opportunities, and also find villages a better place to live (at least as compared to urban slums where they may initially land up would chose to stay in rural India (rather than migrate to urban), they will not migrate to urban areas. This requires **strengthening of health care, education, drinking water, housing in rural India in addition to electrical power**. S&T inputs in these areas would thus be as important to empower the vulnerable in rural India. Thus, following measures are needed for improving the condition of vulnerable section of the society particularly in Rural India:

1. To revitalize Indian Agriculture by

- Improving methods of agriculture with extensive primary value addition
- Providing good quality seeds and fertilizers to the farmers
- Creating water harvesting facilities on extensive scale by dovetailing with NREGA programme to create culture, systems and practices so that usage matches what is captured.
- Minimizing the risk of the farmers by introducing suitable insurance package for crop disease, inadequate rainfall, rationalization of market rate
- Increasing rural connectivity and irrigation facilities
- Providing Agricultural extension services like customized support to farmers, production and distribution of agricultural produce (may be organic with certification system)

2. Introduce innovative livelihood approaches by

- Outsourcing IT services to Rural India
- Outsourcing manufacturing and services to villages and generate wealth & confidence Ex. natural fibre based micro manufacturing units.

3. Rural Industry approaches with product innovation and leveraging locals' knowledge by

- Enlarging scope of Bamboo mission (Affordable rural housing) of DST, improving handlooms with product mix, bring about innovations in micro spinning with small machine to create remunerative value chain
- Strengthen agro-food processing sector through operational structure of SHGs or micro-franchise unit to take up quality production and packaging at village level
- Improving rural infrastructure and communication facilities
- Strengthening ITIs for capacity building of drop-out youths as Masons, Carpenters, Plumbers, Electricians, Fitters, Welders

- **Providing new alternate decentralized power generation** and distribution to rural India : Bio-gas, Bio-diesel, Biomass combustion, Solar photo-voltaic, Solar thermal, Bullock-energy energy, Thermal energy

4. Introducing Financial services in villages like ATMs, loan facilities

5. Social approaches

- To provide health care facilities in the villages - Tele-medicine technology: Integration for rural health practitioners, diagnostic tools
- To involve youth to the development process : On problems of informal sector and other disadvantaged groups; to research on location specific problems:
- Drinking water: Potential for use of herbs for purification
- To encourage innovation and entrepreneurship : Leveraging grassroots innovations documented by NIF
- Creating market for rural products like Vyapaar sewa portal

S & T innovation need to be scaled up with *in situ* value addition to create successful enterprises with skill upgradation and capacity building (in traditional as well as new trades and practices – with an approach earn while you learn options) of vulnerable sections of the society for making commercial and social impact with end to end linkages.

4.2. II. Effective Technology Delivery Mechanisms/Models for vulnerable sections

Technology delivery mechanisms play a vital role in helping the benefits of S&T reach the vulnerable sections. There are many technologies developed by research and academy institutions, which are useful to the vulnerable sections and public at large. But many of them do not reach to the needy, due to non availability of effective delivery mechanisms and sometimes due to non sustenance.

Some models in the past have yielded results, which can be mentioned is the Leather Technology Mission of Govt. of India, which has helped in technology dissemination to the needy. The others are KVIC, CAPART and NIF models, which is helping in support and sustenance of the vulnerable sections. Any technology delivery mechanism for the vulnerable sections in the 12th plan should be taken up in Mission Mode, with set objectives, set delivery targets and monitoring mechanism. The implementation should be through social entrepreneurs with monitoring by public agencies.

There is a need to create a databank of the technologies available for the benefit of vulnerable sections with the S&T organizations, including academy in the country and screen them through a committee of experts in the relevant areas. Get a bankable document prepared by the experts for the selected technologies. Develop human resource, who could volunteer to disseminate the technologies to social entrepreneurs or the beneficiaries directly. The fund release mechanism should be through the mission mode project system, working exclusively for this.

An independent team should be working to oversee the implementation and benefits accruing, to help in advising the mid course corrections.

While the areas where focus needed for vulnerable sections is common like food, shelter and health, but there are region and location specific problems which need to be addressed. These have to be reassessed. One programme which needs to be looked more closely is the effects of climate change on the vulnerable sections.

The success and sustainability of the programmes depend on the institutional framework provided and the governance mechanism adopted for implementation. **A robust institutional mechanism along with good governance** provides tremendous synergy and therefore there is a clear need to emphasize on this theme.

It would be pertinent to review the initiatives taken up by the Government during the 11th Plan period. Many of these initiatives have tried to minimize the drudgery that the weaker sections face in their day to day activities. Elimination of unnecessary labour and drudgery would be a welcome step. From the background note given above it is obvious that a suite of activities had been taken up Ministry of S&T (DST & DBT) and the Ministry of Earth Sciences. It would be useful to closely evaluate the progress/achievements under each of these elements so that the promising ones can be taken forward in the 12th Plan. It would be pragmatic to build on those elements that have already demonstrated a value rather than taking up de-novo activities in the 12th Plan.

As estimated elsewhere (Ref:-Prof. Anil Gupta), there are one lakh post offices and a large number of KVKs in the country. These represent a huge untapped potential that can be used for taking the benefits of S&T to the unreached. What is required here is an imaginative plan of action that would be bold enough to break away from the existing practices and procedures.

The following steps are suggested towards Technology Delivery Mechanisms:-

- a. Establishment of a database of promising technologies that can be taken up for widespread adaptation.
- b. Dovetailing the activities for weaker sections through corporate houses as a part of their CSR activities.
- c. Establishment of Technology Centres for SCs & STs/Women Technology/Biotech Parks. The Women's Technology/Biotech Park at HESCO, Dehradun and Siruseri, Chennai can be a model.
- d. Setting up of Rural Bio-resources Centres to provide technology backstopping and other inputs such as planting material, seeds etc. for Agri-horti activities. These Bio-resources Centres should also have effective buy back arrangements with small farmers/entrepreneurs.
- e. Supplement the national activities that are aimed at providing safe drinking water. This would involve a suite of technologies for desalination, removal of toxic substances and pathogenic organisms.
- f. It would also be pertinent to focus on innovative and cost effective methods to handle sewage in rural areas.

- g. The M.S. Swaminathan Research Foundation has effectively demonstrated the use of mobile network to keep fishermen informed of the conditions in the sea to help them to decide on fishing operations. The use of mobile network system as a platform for diverse use such as Tele-medicine, Early Warning Systems and Educational purposes should be worked out.
- h. Technology delivery or dissemination is a complex process requiring systems of adaptation, absorption and most important hand holding. It is not often appreciated that such technology transfer is a specialized task with its own requirements of expertise and experience, and can not simply be left either to the technology developer or the user, at least in the initial period before the technology itself becomes much better known. It bears reiteration that technology delivery presumes that various elements of the technology package or model have been worked out and have been thought through taking into account backward and foreword linkages. In nutshell, technology delivery may be seen, not as a “one off” task but as a complex set of activities comprising the following major steps or elements:
- Feasibility study and need assessment for vulnerable sections in identified area.
 - Networking and motivation of beneficiaries or grassroots partners.
 - Preparation of DPR.
 - Location specific technology customization and adaptation.
 - Erection and commissioning of production unit/common facility centre (plant and machinery), process optimization for micro-enterprise creation at individual or group or cluster level.
 - Training cum production, enterprise management and other HRD and capacity building.
 - Trial production and marketing.
 - Hand-holding, social engineering, managerial inputs and trouble shooting.
 - Towards full scale production and long term sustainability.

In the above context, the Working group felt that S & T based VOs, government agencies, district level administration, and initiatives from the industry under CSR have been successful in disseminating technologies for the socio-economic upliftment of the vulnerable population up to a point. The challenge is to establish synergy among all these efforts and stakeholders, which are often fragmented and needlessly duplicated, in order to nucleate new initiatives and to strengthen existing ones.

The technology institutions and research laboratories have expertise in technology development but have almost no grass-root level outreach/contacts. The VOs with S & T base on the other hand has limited technological expertise but have excellent field presence. In many instances, VOs with S & T capability have worked on improvement/up gradation of some demand driven technologies up to a certain point but are not competent to take it beyond this level to a possible state of art. It is here that the specialized institutions can help and use their expertise to improve the technology further and also assist the VOs to then transfer the improved version to address the problems of

vulnerable population. Limited examples of such interface and networking do exist but the challenge is large scale replication of such endeavors all over the country.

In this context, the Working group felt that an intermediate institution/centre located in semi or peri urban area with a specific mandate for effective technology delivery to vulnerable sections could provide just the right linkages and interface among all the stakeholders. There are some lessons and insights available from models of rural technology delivery through All India Co-ordinated Programme of SEED/DST, DBT and ICAR. A very successful model of such a collaborative technology customization and delivery exist under a flagship scheme of Long term core support of SEED/DST to science based voluntary organizations i.e. Technological Advancement for Rural Areas (TARA) to provide S & T based solutions for addressing challenges of weaker sections of the society in rural areas. These 20 core supported groups have played a vital role in technology generation/up gradation as well as delivery/transfer through decentralized and networked production systems to address livelihood issues of women, SC, ST population in the country. Such experiences have shown that economies of scale can be achieved in small rural settings by adoption of appropriate technologies and production strategies thus generating employment close to source of raw material as possible. It is therefore necessary to institutionalize such interactions between R & D Institutions and S & T field groups having basic competence in technology adoption and delivery at local level. These institutions could be called technology Delivery centres for Vulnerable Sections and operated by VOs. They can be encouraged to have MOU proximate and other national institutions/laboratories for access to technologies developed and subsequent field validation; modify and fine tune the technologies if required under field conditions; develop business models and provide complete technical support for effective transfer of the entire technology systems/services for improved quality of life of vulnerable population as per need.

4.2.III. Programmes for Areas which are Geographically/Climatically Vulnerable:

Environmental changes are posing a big challenge to the society at large because the risks associated with these changes are immense and highly uncertain. Societal vulnerability to the risks associated with climate change may exacerbate ongoing social and economic development program. This is particularly true for those parts of societies dependent on resources that are sensitive to changes in climate. Several initiatives have been taken by Government of India to study the vulnerability and assessment of climate change on different sections of society pertaining to:

- (i) Coastal zones
- (ii) Natural Eco systems
- (iii) Water Resources
- (iv) Forestry
- (v) Agriculture
- (vi) Health
- (vii) Infrastructure
- (viii) Industry
- (ix) Energy

- (x) Others (carbon sequestration through forestry, reducing CO₂ emissions)

These efforts have been generally ineffective due to lack of:

- (i) Resources
- (ii) Models
- (iii) Trained manpower
- (iv) Sustained commitments

While all the initiatives taken thus have shown some results but with the challenge of the environmental changes looming large in the background, our efforts should be more focused and committed towards creating opportunities for sustainable development of the society at large.

Climate change will affect different segments of society differently because of their varying exposures and adaptive capacities. Some sectors are more sensitive and some groups in society more vulnerable to the risks posed by climate change than others as they have few resources and few choices and have little adaptive capacity. The capacity to respond or adapt is often limited by the lack of resources, poor institutions and inadequate infrastructure. Vulnerability to climate change can be reduced by introducing development programmes aimed at increasing the adaptive capacity and resilience to this emerging global problem.

Climate Change issues:

- It is predicted that in the years to come, there is going to be acute shortage of water and food and greater risks to health and life as a result of climate change
- The prediction in rise in temperature by 1-2.5⁰C, will seriously affect the crop yields leading to increased risk of hunger
- There is an increased risk of extinction of 20-30 percent of all plant and animal species for eg coral reefs, forests, mountain habitats
- Greater risk of water stress
- People living in the catchment area of the Himalayas, face increased risk of floods as glaciers retreat. While people dependent for water on these glaciers face the threat of drought due to water scarcity and soil erosion
- Sea-level rise will lead to inundation of coasts and small islands may face complete inundation.
- Greater frequency of tropical cyclones will pose increased risk to life and livelihoods of people along the coastal regions of the country.
- Rise in extreme events like heavy precipitation, heat/cold waves, wet/dry spells can cause risk to life, property and health to the population living in the affected areas.
- Rise in temperatures can lead to forest fires thus causing devastation to life and property.

Sectors that will be affected by climate change:

- Sectors vulnerable to environmental changes (rise in temperatures, precipitation and extreme events, sea-level rise etc)
- Socio-economic and related sectors (water resources, agriculture and food security, human health)
- Terrestrial ecosystem and biodiversity
- Coastal zones

Targeted Vulnerable Population:

- Any section of society which has limited adaptive capacity, poor infrastructure, lack of resources and lack of knowledge of risks for eg: farmers; fishermen; rural poor; underprivileged; women etc
- Population that is geographically and climatologically vulnerable for eg: coastal population, people living in the terai region or the foothills of Himalayas; people living in high terrain or upper reaches where the infrastructure and resources are inadequate; people living in the arid and semi-arid region of the country; people living in areas frequented by increasing floods and cyclones

Programme Objective:

To develop innovative S & T programmes necessary for sustainable development of the vulnerable section of the society through (i) generating resources that are socially, technologically and financially acceptable (ii) that increase the adaptive capacity and resilience to the effects of climate change

Way forward:

(a) Modeling, assessment and reporting

- Top-down approach
 - Monitoring climate change through systematic gathering of data; running high resolution climate models to forecast climate change scenarios to understand the impending impact
 - Integrate climate change data with socio-economic data through development of appropriate models, tools and technologies
 - Sharing experience and information through workshops, symposia, science journals and websites
 - Training on the use of models and tools through master trainers
- Bottom up approach
 - Gathering information on local traditional knowledge of communities for coping with climate change
 - Building upon the local and indigenous knowledge and ingesting it with technological information to help in development of specific strategies and policy implementation.

(b) Initiate programs for adaptation, planning and practices

- Adapt to climate change: Adaptation is a process through which the vulnerable section of the society gears up to cope up with an uncertain future. This can be done by taking appropriate action to negate the effects of climate change through development of programmes for
 - I. Improving the technical capability to assess the adaptation needs and integrate with the sectoral development programme in the areas of water, agriculture, coastal zones and natural ecosystems
 - II. Need based technology transfer like new irrigation system, drought resistant seeds, insurance schemes, crop rotation patterns
 - III. Early warning system to help increase awareness and initiate action
 - IV. Develop R & D support in areas of sustainable livelihood, better productivity and improved resource conservation. Today the entire world is facing the challenge of increased degradation of forest and land ecosystem, biodiversity loss, climate change and the associated variability in weather and climatic patterns, depleting drinking water availability, increasing energy prices etc. All these come in the way of our economy.
 - V. Develop appropriate management techniques and innovative scientific tools and techniques for an effective sustainable development. This can be achieved through collective cooperation between different stakeholders which includes government functionaries, industries, academia and the society at large.
 - VI. There is a need to build S & T programmes that involves the collective wisdom of all sections of society. The areas where the S & T programmes can be considered are:
 - Green architecture – energy conservation
 - Reducing carbon footprint ; adopting green environment
 - Clean and Renewable energy - Energy-efficient building/ gadgets; Solar and wind energy
 - Water recycling- potable water management
 - Food Security : Sustainable agriculture; soil-water management, reduce soil salinity
 - Health security - Adaptation and resilience; Drugs/Pharmaceuticals
 - Waste management : recycling
 - Coastal management S & T programmes
 - Sustainable transportation/mobility – Green fuel

- (c) Some of the development programmes in vulnerable sectors that can be developed and adopted in the country are listed below. A few of them have also been identified by the United Nations Framework Convention on Climate Change (UNFCCC) for the developing nations.

(i) Enhancing knowledge

Improving forecasting capabilities for agriculture, extreme events and disaster management;

(ii) Water Resources

- Protection of groundwater resources through improved water management for drinking and agriculture through understanding water flows and water quality, encouraging rainwater harvesting and water storage and diversification of irrigation techniques;
- Water policy for better water management
- Desalination
- Flood control measures and drought monitoring
- Addressing the issue of changing water cycle

The changing water cycle will have direct impact on the livelihood and therefore it is pertinent to carry out research in the following themes.

- Land, Ocean and Atmosphere interaction
- Precipitation
- Detection and Attribution of water Cycle changes
- Consequences of Changing Water Cycle
- Research inputs for adaptation Strategy

The Ministry of Earth Sciences (MoES) has already taken some initiatives in the 11th Plan to undertake joint studies on changing water cycle with the Natural Environment Research Council, UK. However the following aspects may be considered in the 12th plan to address the issue among the vulnerable population

- Response of forests and agro-ecosystems to extreme rainfall events in the Western Ghats
- South Asian Precipitation
- Hydro-meteorological feedback and changes in water storage and fluxes in north Indian basins
- Mitigating climate change impacts on Indian agriculture through improved irrigation water management
- The structure and dynamics of groundwater systems in northwestern India under past, present and future climates, and
- Understanding the role of different regional drivers on erosion and flood risk hazard in the Ganges –Brahmaputra basin

(iii) Agriculture and Food Security

- improved food security through crop diversification, changes in fertilizer use and application, changes in sowing and harvesting time
- Development of drought, flood and saline tolerant crops,
- Development of seed banks
- Educational and outreach programmes on Soil-water conservation and management
- improving livestock and fisheries breeding and farming techniques,

- developing local food banks for people and livestock, and improving local food preservation;
- better land and land use management through erosion control and soil conservation measures, agro forestry and forestry techniques,
- forest fire management and finding alternative energy sources to wood and charcoal, as well as better town planning;
- Tax incentives/subsidies

(iv) Coastal zones and marine ecosystems

- Building sea-defense systems to fight sea-level rise
- Public awareness to improve the protection of coastal and marine ecosystems
- Integrated coastal zone management
- Protection and conservation of coral reefs, mangroves, sea grass
- These are under threat from undue human intervention and also climate change as both transform the coastal ecology. Two major issues are (a) excessive nutrient loadings in the coastal waters, and (b) rise in SST due to climate change alters the metabolic processes that affect the health of the corals. MoES plans to undertake the following in the 12th plan.
- Development of a coupled hydro-ecosystem model to predict primary and secondary level production.
- Preparation of a sustainable management plan to help the local and vulnerable community.
- coastal zone management including coral monitoring and restoration and improving coastal defences through afforestation, reforestation
- Assessment of the **vulnerability of the Indian coastline** due to Tsunamis. Sea level rise, storm surge, extreme waves, coastal erosion, coastal geomorphology, coastal slope etc. The following aspects may be considered in the 12th plan.
 - Multi hazard modeling and development of the Indian coastal vulnerability maps – this will provide details of extent of risk due to hazards, geographical impact, level of risk and geographical details (extent of human settlement, resources and infrastructure)
 - Development of a web GIS based coastal vulnerability information system – this will help to disseminate information about coastal vulnerability; future planning about coastal activities

(v) Health Care

- Development of Early warning systems: improved health care through flood shelters and assistance shelters as part of community emergency, preparedness programmes,
- better health education,

- better access to primary health care such as distribution of treated mosquito nets and better malaria surveillance programmes and habitat clearance;
- Improved emergency response
- Improvement of environment quality

(vi) Terrestrial Ecosystem

- Control of deforestation, reforestation and afforestation
- Development of forest fire plans
- Carbon sequestration in forests
- Creation of parks and biodiversity corridors
- Identification and development of species resistant to climate change
- Strategic planning for Protection of plant and animals

(vii) Capacity building and human resource development

- capacity-building to integrate climate change into sectoral development plans, involving local communities in adaptation activities, raising public awareness and states & UTs to prioritize their urgent adaptation needs.
- Conducting training and awareness programmes to educate people
- Training master trainers for community based education programmes

4.2.IV. Evolving Workable Technology Models for Disability & Elderly:

The World Report on Disability, released on 9th June 2011 by WHO and World Bank, finds that the proportion of disabled people is rising and is currently at 15 percent of the global population. Despite many attempts at creating an inclusive society, the report found that differently-abled people are unable to lead independent lives and one in five of them experience significant difficulties. In India, the normal incidence of disability in a healthy population will require us to provide support to about 5 million individuals. In addition, we expect that the number of aged people who will require Assistive Technology will increase rapidly in the coming decades. Most assistive technologies are being imported at unaffordable costs. Thus, there is a need for a focused effort to develop indigenous technologies for persons who are differently-abled.

Assistive Technology Development

In recent years, we have witnessed the rapid adoption of consumer technologies such as computers, mobile phones and data networks that have spawned initiatives in e-governance, internet banking, and railways. In addition, manufacturing automation, nanotechnology and medical diagnostic instrumentation, are also being driven by market forces and becoming common. However, unlike these examples, assistive technologies (AT) require societal and governmental support before they can achieve significant market penetration. An assistive technology device can be defined as “any item, piece of equipment, or product, whether it is acquired commercially, modified, or customized, that is used to increase, maintain, or improve the functional capabilities of

individuals with disabilities” . A typical consumer for AT products is unable to access the product due to a combination of societal and economic factors. Consequently, manufacturers are unable to sustain technology development, and scale up production to meet the needs of society.

There is a need to develop a complete eco-system, captured in Figure 1, which will

- seed basic research on new technologies,
- support entrepreneurial activities,
- encourage manufacturers and
- create after sales support through trained rehabilitation workers.

The members of the eco-system would be linked through active collaborations between

- end-user and primary care-giver
- schools and institutions for the differently-abled
- students and staff in academic and research institutions
- techno-entrepreneur, angel investors and venture capitalists
- design houses, prototype fabricators, manufactures and sales support
- policy makers in NGOs and Govt. institutions

Active collaborations, under a framework of public-private-partnerships, would be facilitated through **Nodal Resource Centres** (NRCs) who would also import and showcase the latest and best technologies in the space of rehabilitation and assistance. Innovators must study and benchmark their ideas against these products, while developing ideas for indigenous and customized applications. Technology business incubators around the country will be encouraged to support ideas in this space, by helping innovators create feasible business plans. These business plans will be supported by government policy that requires the implementation of assistive technology to create a truly inclusive society.

Classification and Standardization

Functioning and disability are a complex interaction between health, environment and personal factors, a combination that establishes "a person in his or her world". For successful technology penetration, we must understand the prevalence of disability in terms of statistics, spending power and access to products. In a fragmented delivery system, the burden of problem identification, setting up technical specifications, and repeated attempts at prototyping and testing, drives up the costs to the point of making technology unaffordable. Proper classification and standardization can alleviate this problem.

The World Health Assembly, under the auspices of WHO, approved the International Classification of Functioning, Disability and Health and its abbreviation "ICF", in May 2001. The ICF is neutral to etiology (origin of the disability) and is instead composed around

- Body functions and structure

- Activities (tasks and actions by an individual) and participation (in a life situation)
- Additional information on severity and environmental factors

The classification is interactive and dynamic allowing for an assessment of the degree of disability. The 2007 addendum, ICF for Young Children (ICF-CY) expanded ICF for adults to include development aspects for children and youth e.g. the adult activity of leisure or recreation has been expanded to allow for a child to play as an onlooker, in parallel or by himself/herself. The language of the ICF is neutral as to etiology, placing the emphasis on function rather than condition or disease. It also is carefully designed to be relevant across cultures as well as age groups and genders, making it highly appropriate for heterogeneous populations.

Statistics, collected under the latest census, must be augmented with data from schools and centres that are accessed by the differently-abled. Thereafter, we must establish proper standards using the ICF and ICF-CY, in relevance to the Indian socio-economic context. Standards will address the functional aspects of hardware devices, user interfaces, aspect ratios, mounting positions, usage durations, etc covering both electronic functionality and mechanical access. The standards will need to be communicated to the Bureau of Indian Standards, allowing AT products to avail of ISI markings.

In a complete eco-system, successful field trials will be aided by staff members of a NRC who will act as an intermediary between end-user, rehabilitation worker and the technology provider. ICF then becomes a common language across the different specializations.

Concepts of Universal Design

Universal Design involves a fundamental shift in thinking about design, particularly with regard to designing for people with disabilities. Traditional design approaches add accessibility to otherwise inaccessible objects and standard designs. Universal design is based on the premise that buildings and products can and should be designed to be usable by a broader segment of the population. Simple changes to an existing design can often make a product, or a building, or a service, accessible to the differently-abled. In civil society, there is a need for ramps near staircases, low chassis public transport vehicles, elevators in subways and train stations. The concepts of Universal Design, when incorporated during the conceptualization of a product or service, serve to both expand the consumer base for the manufacturer and also sensitize society to the needs of the differently-abled. Good examples of universal design that encourage inclusion are printed matter with tactile graphics and Braille, websites that have voice-over and traffic lights with beeps pedestrian crossings.

Government policy can create incentives for the introduction of Universal Design into academic curriculum, while NRCs popularize the concept across engineering disciplines.

Training and Awareness

Unlike most other commercial products, the success of Assistive Technologies depends largely on our ability to conduct successful awareness campaigns. Since the user population is already disadvantaged, access to information about useful products, and then the adoption of these products requires

- more development and prototype cycles due to the diverse and complex nature of their requirements and the difficulty in translating their needs into technical specs
- customization to address the functional needs of the end user

NRCs are required to conduct regular awareness campaigns and provide adequate training and after-sales support. They will interface with the District Rehabilitation Officers (DROs) to ensure continuity of support and will aim to train and placement of at least one staff member (diploma graduate) on assistive technology in each district.

Consolidation of efforts and Transfer of Technology

Academic institutions and research laboratories play an important role in advancing technology. We must encourage transfer of technology from these institutions to industrial partners for prototyping, fabrication, testing, and field trials, before final production. Unlike other technologies, NRCs will play a key role in facilitating the transfer of technology, and coordinating research efforts with end users and industrial partners. NRCs would act to bring together angel investors and venture capitalists into the mix at the appropriate juncture to facilitate evaluation and funding for new technologies.

There have been many instances of successful development of assistive technology in India. The Jaipur foot, callipers made of composite materials developed by DMRL, motorized wheelchairs and the Braille typewriter by Worth Trust, solar battery charger for body level hearing aids developed at the Ali Yavar Jung NIHH, are all examples of excellence in technology. There is however a need to consolidate these efforts at a national level and make the technology available across multiple geographic zones. The Punarbhava web-portal (developed by Media Labs and currently managed by Rehabilitation Council of India) is a beginning. There is also a need for such activities to be localized (with local language content) and yet consolidated across the nation.

NRCs can play a big role in such activities, even as they act as centers that provide technical assistance in case of customization or after-sales support. Thus, NRCs will bear the burden of translation of user specifications into a language suitable for technologists and manufacturers, while also scoping out the market potential and estimated reach of a technology. Through active collaborations with the staff in the District Rehabilitation Office, the NRCs will showcase the latest assistive technology, and also enable the distribution of both products and technical know-how.

Rehabilitation

The partnership between technologists (who are sensitized to user needs), rehabilitation

workers (who facilitate the use of technology) and the end-user, is critical to the success of Assistive Technology. Using the ICF, all aspects of a person's life (development, participation, and environment) are incorporated into AT development. Being aware of the daily activities of the user, a problem solving sequence set up by the ICF can be used by a rehabilitation worker. The objective is to use intervention at current level (current abilities) to prevent or modify events at a succeeding level (through participation). For example, providing an alternate and augmentative communication (AAC) device will foster effective interaction and increase one's participation with his or her family.

NRCs will empower rehabilitation engineers through ICF in their daily work with the differently-abled, and will also enable working with hospitals and health care administrations and policy makers. Since the focus is on Assistive Technology development, there is a strong technical component that the rehabilitation worker will first need to be trained upon, and the AT product will be customized for the user.

Export Potential

Assistive technologies are a niche market area. While developing our indigenous strengths, we also have the ability to cater to other parts of the world. With a strong history of working with the differently-abled, Indian expertise in rehabilitation is often sought from countries in South Asia. These countries also currently import most of the assistive technology, and look to India to provide less expensive solutions. We are also active participants in bodies, such as ICEVI, Sense International, Perkins, and CBM, that have strong international programs. Hence, there is a significant opportunity for Indian business to play a role in developing products that address their needs. We must use our goodwill among the NGOs to seek new mechanisms for interactions with nations, especially in our neighborhood and in the Asia-Pacific region.

The members at each NRCs come with expertise in working across different geographies, and with an interdisciplinary approach to technology development. Hence, they would be best suited to working with industry to identify new opportunities for exporting indigenous assistive technology.

Subsidizing Development

Government can play a big role in subsidizing the costs of technology development for the differently-abled. Subsidies could be both direct and indirect.

1. **Direct subsidies:** The current subsidies under the ADIP scheme are insufficient to support the development of the latest in Assistive Technology. Direct subsidies should be provided to at least Rs. 20,000, or 20% of the cost of the product(s). Nodal Resource Centres will be responsible for the functional evaluation (as per ICF and ICF-CY) standards to determine the use of appropriate AT, subject to periodic assessment and review. The subsidy will be specific to the user, who can then exercise his choice in purchase from one or more indigenous manufacturers.

2. **Indirect subsidies:** These are subsidies that are provided in terms of
- a. start-up grants (up to Rs. 25 lakhs with a stringent time-bound review process)
 - b. changes in Government policy that support inclusion, e.g. mandating that all e-governance initiatives be made accessible to the differently-abled, will incentivize development of text-to-speech technologies in internet browsers.
 - c. specific support for academic programs, manpower training, engagement with DRCs, etc
 - d. Procurement of assistive technologies for the nodal centres as demonstrations and for purposes of reverse engineering and customization to the Indian context.

To coordinate and facilitate such activities, it is recommended to form nodal resource centres, under the coordination of **Centres for Accessibility and Rehabilitation Engineering (CAREs)** with a mission to develop assistive technology with respect to all types of physical, mental and learning disabilities and make them available as commercial products. The needs for the devices will be identified in close consultation with the user agencies and beneficiaries.

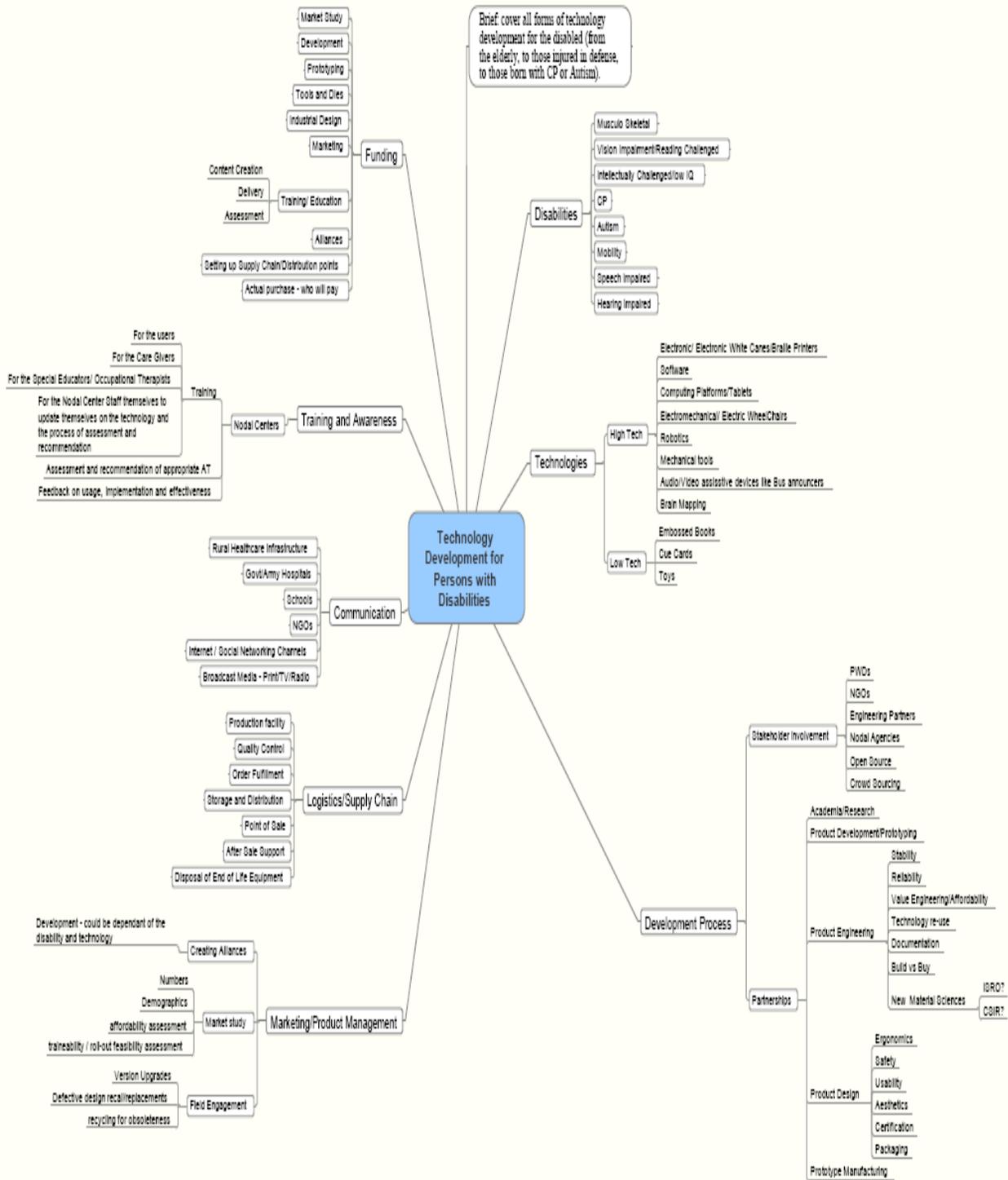


Figure 1: Mapping technology development for the differently-abled

Recommendations

5. Recommendations of the Working Group on S & T for Vulnerable Sections of Society:

A. Generic Recommendations:

5.1 Preamble for Intervention

- S&T can make a difference.
- Traditional knowledge and creativity of people is important.
- S&T inputs are not available off-the-shelf.
- Issues often span many disciplines. S&T institutions develop technologies but not field models leading to sustainable enterprises.
- The ENTERPRISE - not the technology - is crucial for sustainability, reliability.

5.2 Emerging Need:

5.2.1 Solution science and Linkages

- Scoping and Strengthening of R&D initiatives for Weaker Social Segments.
- Confront the problem head-on: make things happen;
- Initiate missions: to implement co-ordinated, goal-specific & time-bound developmental projects;
- Broad Sectors to be covered: Fuel & Energy, Up gradation of Tools and implements- agriculture/artisans/Elderly/Women, Post harvest technology, Water quality monitoring and management, Agriculture/Horticulture diversification, Organic farming/ Group Certification, Soil fertility management/Biological control of Pest, Value addition to agricultural produce and Affordable Health care.
- Create a databank of the technologies available for the benefit of vulnerable sections with the S&T organizations
- Build upon the good work already done but which has not yielded the desired results;
- Strengthen interface between respective Ministries/ Departments/ Institutions;
- Involve PRI and local governments in programmes and local level implementing agency.

5.2.2 Strengthening Human capacities

- Proactively promote Individual inputs towards R&D to address issues for vulnerable sections.
- Groups like primitive tribal groups, adolescent girls, the elderly and the disabled need special interventions
- Promote individual innovations to solve grass root problems.
- Involve larger number of scientists/technologist in technology adaptation and transfer programmes.
- Large scale capacity building programmes of youth in rural areas.

- Mobilizing NREGA for documenting traditional knowledge about climate change, eco-system properties, health and culture

5.2.3 Strengthening Institutional capacities

- State S&T Councils, KVK's as tools for technology absorption and deployment.
- Strengthening of S&T capability of Vol organizations by long term support.
- Networking of institutions based in rural areas.
- S&T awareness and demonstrations with Panchayati Raj Institutions
- Stimulating states for investments into deployment of technologies: Under state-center technology partnership models.

5.2.4 Technology Development and Deployment

- Strengthening initiatives in technologies for soil fertility management, diversified agriculture, conservation agriculture, value addition at production site, cold chain management.
- Technology up gradation in traditional occupations (especially energy needs).
- Orienting fundamental research to solve problems like NCD, TB, water, energy.
- Validation of traditional knowledge

5.3 Refocusing Strategy in 12th plan: Connecting, Creating, Collaborating, Co-Designing and Communitizing S & T based programmes so that socially disadvantage groups become a part of main stream for Inclusive development by mobilizing and integrating efforts:

- Towards Increasing per capita Rural GDP
- Improved livelihood, infrastructure, health, and education
- Decentralized power generation and distribution owned & managed by community
- Confidence in their knowledge and abilities
- Access to financial services
- Support grass-root innovators and Innovations
- Raw materials, agricultural and forest produce should move out of villages only after extensive value addition *in situ*.

B. Specific recommendations for S&T based Solution Programmes for Vulnerable Sections of Society

i. Evolving Area Specific Vulnerability Programmes: Working group strongly recommended developing and implement specific programmes by S & T departments for disability/age related vulnerability; for geographically vulnerable population (remote areas); climatically vulnerable population (Difficult areas, coastal, arid, island); disturbed area Vulnerability and economically vulnerable (Poverty) issues focusing in following areas:

- Clean and Renewable energy / gadgets; Solar and wind energy; micro-hydel power for decentralized generation and utilization of power involving community (47.8 percent of ST villages are not electrified).
- Water Security: Cost effective technologies for Recycling and purification - potable water management.
- Conservation, Agriculture & Food Security: Sustainable agriculture and value addition; Agro-biotechnology tools for soil-water management and improved crop productivity etc.
- Disaster mitigations
- Appropriate agriculture packages
- Enterprise promotion
- Aids and accessories for PWDs'

ii. Provide Innovative Livelihood Opportunities:

- Creation of massive livelihood opportunities in rural areas especially for youth/drop outs
- Outsourcing of manufacturing and services to villages : To SHGS/micro-manufacturing units to rural India not involving heavy machinery and large power
- Outsource IT Services to Rural India

III. Rural Industry Focus: Product Innovation & Skill Up gradation

- Enlarging scope of Bamboo mission (Affordable rural housing), improving handlooms with product mix
- Innovations in machinery for use in enhancing productivity & to create remunerative value chain
- Strengthen agro-food processing sector through operational structure of SHGs or micro-franchise unit to take up quality production and packaging at village level
- Leveraging agri-byproducts (Broom grass, banana stem fibres, Wooden Durries from natural fibres) at production site
- Improving rural infrastructure and communication facilities
- Providing new alternate decentralized power generation and distribution to rural India
- Support to Rural Enterprises: Production Models of self-help group, cooperatives, micro-franchise units need to be explored Ex. Amul

IV. Leveraging Grassroots Innovations

- Bio-diversity based knowledge systems: No raw material should move out of forest without some value addition *in situ* so as to expand participation of common people in S&T pursuits
- Grassroots innovation fund for investment in small technologies for social / commercial market
 - S&T budget towards value-add of unique traditional knowledge

- Incubation support for grassroots innovation
- Innovation need to be scaled to successful enterprise with end to end linkages ensuring benefit sharing with community

V. Other Needs: Affordable Support Services

- Healthcare
 - Set up service labs for nutritional characterization of traditional foods
 - Documentation and validation of Herbal and folklore medicines
 - Soil Health determination and enhancement.
 - Certification of Local Healers and Rural Healthcare Providers
 - Effective technology delivery model for preventive health of children and NREGA workers (immunization, nutrition)
- Safe drinking Water
- S & T based Skill Development
- Habitat

VI. Proposed S & T based Solution Programme for Effective Technology Development and Transfer: The working group concluded that there is a need to work with a bottom up approach for tinkering traditional technologies to reach vulnerable population in the country so that the gap between technology offered and perceptions of people along with technophobia and inertia can be addressed. The working group felt that its mandate is best fulfilled precisely through meaningful contribution in this direction if following is adhered for the 12th FYP:

- S & T based innovative technology development and delivery programmes for the 12th plan period to be formulated especially for the vulnerable section of society basically around sustainability science to involve and empower such disadvantaged sections of the society with new/improved skills and knowledge for livelihood security. It requires building specific S & T programmes that involves the collective wisdom of all sections of society.
- S & T based solution programmes/areas for capacity building (both institution and human capacities) and sustainable development that need to be actively considered for development of vulnerable sections of the society are:
 - Clean and Renewable energy / gadgets; Solar and wind energy; micro-hydel power for decentralized generation and utilization of power involving community.
 - Water Security: Cost effective technologies for Recycling and purification - potable water management.
 - Agriculture & Food Security: Sustainable agriculture and value addition; Agro-biotechnology tools for soil-water management, improved crop productivity, reduce soil salinity.
 - Affordable Health care & Health security - Adaptation and resilience; vector control services; Drugs/Pharmaceuticals. Promote capacity-

building among health professionals to ensure conformity with the right to health in service delivery. Green architecture – Energy-efficient building.

- Reducing carbon footprint; adopting green environment.
- Waste management: recycling.
- Coastal management S & T programmes.
- Sustainable transportation/mobility – Green fuel.
- Some of the areas that need immediate attention in the wake of changing climate are Sea-level rise, Soil-erosion, Extreme weather conditions including wet & dry spells, Heat wave/cold wave conditions, Forest Fires, Drinking water.

- S&T interventions should be rooted in rural areas user friendly.
- **Engagement with youth** in developmental activities has been rather poor and the need of the hour is to challenge the youth with solution science and also ignite their potential for innovation.
- There are over 1 lakh Post offices and the over 500 Krishi Vigyan Kendra having a pan India spread. Their services are presently underutilized and can be used for diffusion of technology.
- S & T innovation need to be scaled up with *in situ* value addition to create successful enterprises with skill upgradation and capacity building (in traditional as well as new trades and practices – with an approach earn while you learn options) of vulnerable sections of the society for making commercial and social impact with end to end linkages.
- Any technology delivery mechanism for the vulnerable sections in the 12th plan should be taken up in Mission Mode, with set objectives, set delivery targets and monitoring mechanism. The implementation should be through social entrepreneurs with monitoring by public agencies.
- There is a need to create a databank of the technologies available for the benefit of vulnerable sections with the S&T organizations, including academy in the country and screen them through a committee of experts in the relevant areas. Get a bankable document prepared by the experts for the selected technologies.
- Climate change is an important area which needs immediate attention in the wake of changing climate, soil-erosion, extreme weather conditions, forest fires impacting livelihoods of the targeted communities like SCs and STs. Low cost low carbon resource management, initiatives for coastal fisherman, island development should be focused.

VII. Major Areas of Interventions for Vulnerable Sections

a. Gender Vulnerability:

- Women Development and diffusion of gender responsive technologies like drudgery reduction in agriculture operations and ergonomically designed tools and implements Enhanced Nutrition awareness and availability
- Prevention of NCD&CD burden

- Setting up of Women technology/biotechnology parks at block level for providing technical back-up support for enhancement of sustainable livelihood opportunities through capacity building, entrepreneurship development

b. Socially Vulnerable - SC Population:

- Value addition in Traditional occupations/ artisanal trades
- Integrated Mission on S&T-driven Development of SCs with Cluster approach for transforming labourers into productive occupations
- Expanding Productive Occupations Domain: Increasing productivity of small agriculture, animal husbandry, masonry and artisanal trades.
- Capacity building & training programmes for youth

c. Socially Vulnerable- SC Population which constitute 8.14 % of the total population and live in about 15% of the country's area.

- Supporting small-scale forest-based enterprises by ensuring a sustainable supply of input materials, providing managerial and technological back-up support with improved access to credit and marketing linkages;
- Affordable Health care & Health security : Nutrition, Genetic disorders; Communicable disease burden (Vector borne disease TB); Non Communicable disease burden (fluorosis, IDD, Arsenic)
- Replication of successful technology based models like Wadi Programme for livelihood generation; WWF-DST model for protected areas with multi-sectoral interventions approach having component of water management, nursery raising, MFP processing and value addition, animal husbandry
- Scientific validation of traditional knowledge and management practices - protecting the intellectual property rights of the tribal, especially in the field of traditional system of medicines
- Capacity building of tribal youth leading to entrepreneurship based on simple rural technologies

C. Methodology: Different Approach for making Visible Impact

i. Special Purpose Vehicle Fund

Working group recommended to implement above programme in focused way, a separate budget provision should be made available to Ministry of Science & technology (DST, DBT, DOES) as **special purpose vehicle (SPV)** in the 12th Plan for the task towards addressing problems of vulnerable population through S & T interventions. The government may also consider setting up a social venture fund which should be created for the tribal/SC/Elderly population. The SPV would in turn identify and network partner S & T capable VOs, all with impeccable credentials and track record in different States/Districts, as well as collaborating S & T Institutions in different sectors. These arrangements would provide the necessary technology customization, transfer, technical back-up and hand-holding

services for the upliftment of vulnerable sections of the society. Through this network of mechanism of network partners, the SPV would take full responsibility for all the different aspects of sustainable employment/improved quality of life. SPV would essentially look into:

- Strong networking at field level: VOs-Institution partnership + interface with R&D institutions to address issues for vulnerable sections
- Strong social engineering component to produce large level and wide effects.
- Directed projects especially for non-farm rural enterprises.
- All India Coordinated Research Project on soil, plant, and human health needed
- **CHNUNAUTI (Challenges for Unfolding and Augmenting Technological Innovation for society)** - Mission Programme : To engage young technology students on problems of informal sector and other disadvantaged groups; post persistent technological problems faced by socially disadvantaged groups as challenges
- Location specific programmes to deliver workable technology packages in a time bound manner
- Need Entrepreneurship fund and incubators focused on socially vulnerable groups.

ii. Evolving Directed Programmes:

- Scoping and Strengthening of Ongoing S & T initiatives of 11th Plan for Vulnerable Section
- Expanding Start-up R&D grants for individual and team research
- New modes of selection and decentralized implementation

iii. Systems Approach with Local Institutional Arrangements: Evolving related field models of proven technology.

- The ENTERPRISE - not the technology - is crucial for sustainability, replicability ensuring following
 - System design,
 - Raw material flows over full annual production cycle
 - Product range for existing / potential market conditions
 - Marketing / sales strategies, target clientele, pricing
 - Beneficiaries' role, motivation / incentives, organization
 - Costs and benefits, viability, sustainability
 - Regulatory issues
- Strengthen the interface between respective Ministries / Departments / Institutions
- Involve PRI and local governments in programmes and insist on local level presence of implementing agency.

- The Council of S & T for rural areas set by Department of Science & Technology needs to be strengthened and replicated in a large way.
- Need is to make rural S & T to be focused in larger programmes by involving different S & T Ministries & Departments. In this endeavor, focus should be to make substantial effort to take technology in enterprise mode with commercial viability.

D. Targets & Deliverables: It is proposed to set up about **100 Technology Resource and Delivery Centers (TRDC) /Technology Parks for Vulnerable Sections** at the block level covering around 100 districts during 12th five yr. plan. Besides concerned departments under Ministry of Science & Technology and Ministry of Earth Sciences should have a provision of grant in aid support using proposed SPV fund to strengthen R & D initiatives for vulnerable sections through goal-specific and time bound projects.

Structure of TRDC/ Technology Parks:

Working group felt that existing Science based field groups (Core supported groups/KVKs/State S & T Councils/CSTRI) who have scientific manpower and expertise to work in field conditions may be identified to take up this challenge for creating such centers around them. Working group suggested that an intermediate institution/centre located in semi or peri urban area with a specific mandate for effective technology delivery to vulnerable sections could provide just the right linkages and interface among all the stakeholders. These centers technology delivery centers for vulnerable sections will be set up specifically taking into account the concentration of the geographically vulnerable population (remote areas); climatically vulnerable population (Difficult areas, coastal, arid, island); disturbed area Vulnerability and economically vulnerable (Poverty) to develop and implement targeted programmes of S & T interventions as recommended a under A & B above.

Activities Mandated for TRDC/Parks:

These institutes/organizations having basic competence in technology adoption and delivery at local level will institutionalize interactions with R & D Institutions. They can be encouraged to have MOU proximate and other national institutions/laboratories for access to technologies developed and subsequent field validation; modify and fine tune the technologies. Each centre will develop human resource, who could volunteer to disseminate the technologies to social entrepreneurs or the beneficiaries directly. The fund release mechanism should be through the mission mode project system under SPV, working exclusively for this. Each centre will facilitate conduction of vulnerability audit amongst institution, and encourage an inclusive system of effective technology literacy and delivery, livelihood security, employment generation and governance with local institutional arrangements.

6. Contributors:

Working Group Members:

- | | | |
|-----|--|-----------------|
| 1) | Dr. Shailesh Nayak , Secretary, MoES, Delhi | Chairman |
| 2) | Dr. P G Rao , NEIST, Assam | Member |
| 3) | Prof. A. Jhunjunwala , Professor, IIT Madras, Chennai | Member |
| 4) | Dr. Anil Gupta , IIM, Ahmedabad | Member |
| 5) | Dr. George John , DBT, Delhi | Member |
| 6) | Dr. R. S. Deshpande , ISEC, Bangalore | Member |
| 7) | Dr. P. K. Ghosh , Director, CSMCRI, Gujarat | Member |
| 8) | Shri. G. B. Panda , Sr. Advisor, Planning Commission, Delhi | Member |
| 9) | Dr. S. K. Das , MoES, Delhi | Member |
| 10) | Shri A K Verma , Advisor, Planning Commission, Delhi | Member |
| 11) | Dr. Vinita Sharma , Advisor, DST, Delhi | Member Convener |
| 12) | Dr. Parvinder Maini , Scientist F, MoES, Delhi | Co - Convenor |

Individuals:

- 1) **Ajit Narayanan**: Ajit is the Managing Director and Founder of Invention Labs, Chennai. As a social entrepreneur he focuses on building assistive technologies for non-vocal individuals, and is a winner of the Innovator of the year 2011 by MIT Technology Review Magazine.
- 2) **Prof. Anil Prabhakar**, Dept. of Electrical Engineering, IIT-Madras: Prof. Prabhakar actively pursues research in areas of optics, magnonics and rehabilitation engineering. He is a co-inventor of ADITI, a non-contact switch for individuals with cerebral palsy. He is a recipient of the INAE Young Engineer award which recognized his efforts on indigenous development of optical instrumentation.
- 3) **Dr. Jaganath Nayak**: Research Centre Imarat, Hyderabad: Dr. Nayak is a scientist in the Inertial System Group, at RCI. He has lead the efforts on the indigenous design of fibre optic gyroscopes that are now being inducted in our armed forces.
- 4) **Prof. Umesh Waghmare**, JNC SAR: Prof. Waghmare conducts research on materials and their properties. He is a recipient of the Shanti Swarup Bhatnagar award for contributions to nano-technology and nano-materials.
- 5) **Raja Shanmugham**, Happiest Minds Pvt. Ltd., Bangalore: Raja was one of the founder members of Mindtree Technologies, after working at Wipro. Till recently, he headed the activities of Mindtree Foundation in education and in developing assistive technologies

- 6) **Shri Sunil K Agarwal** is working as Scientist in Science for Equity, Empowerment & Development (SEED) Division of Department of Science & Technology, Government of India, New Delhi.
- 7) **Ms. Vishaish Uppal** is Head of Livelihood & Governance Division in WWF India, Lodhi Road, New Delhi.

7. References:

- [1] http://whqlibdoc.who.int/publications/2011/9789240685215_eng.pdf
- [2] Recommendations of the CARE Working Group at the Natl. Conf. on Alternative Communication and Assistive Technology, Mumbai, 14-15th March 2009.
- [3] <http://www.who.int/icidh/>
- [4] <http://accessability.co.in/Article-Universal-Design>
- [5] <http://punarbhava.in>