Nanotechnology for Safe Water: Strategies and Partnerships to Benefit the Bottom of the Pyramid

Consultation Report

21st April, 2011

India Habitat Centre, New Delhi

Organised by

Development Alternatives

In collaboration with

Department of Science and Technology
Ministry of Science & Technology, Govt. of India, New Delhi

DFID Department for International Development

Contents

Background

The Department for International Development (DFID) leads the UK Government's fight against global poverty. To take this agenda forward DFID has established a research programme to help engage with new and emerging technologies which have the potential to benefit poor people and have an impact on poverty.

Under this programme, the Development Alternatives Group (DA) is researching the potential of nanotechnology to provide safe drinking water to the Bottom of the Pyramid (BoP) population. Safe water is a pressing issue in India, with water sources getting increasingly stressed with population pressure as well as biological and chemical contamination. Over 21% of the country's diseases are water related. The unavailability of clean water impacts health, hygiene, food, education and productivity and thus maintains or leads to further poverty. The DA Group brings learnings from its extensive experience in addressing issues related to safe water and water management through innovation and research to this study.

Nanotechnology is an emerging technology that can be used for both detection and purification purposes to provide safe water. The DA Group organised a series of consultative workshops in Bengaluru (4th March,2011) and Mumbai (8th March, 2011) in association with the Department of Science and Technology (DST) - GoI, the UK Department for International Development (DFID) and the Indian Institute of Technology–Bombay. The workshops on *"Access to Safe Water for the Bottom of Pyramid: Strategies for Disseminating Technology Research Benefits"* were primarily sharing and learning events on the current concepts and literature on nanotechnologies of water purification in India. Additionally these workshops attempted to identify the market and policy barriers for nanotechnology and the potential risks nanotechnologies in the water sector pose to health and environment.

The workshop on **"Nanotechnology for Safe Water: Strategies and Partnerships to Benefit the Bottom of the Pyramid"** held at **India Habitat Centre (IHC)** in **New Delhi** on **21st April,** in association with **DFID and DST,** was the **third** and **concluding workshop**. It attempted to use the learnings from the previous workshops in order to move forward and **strategize workable models** to get **feasible** nanotechnology **solutions** for water purification to the bottom of the pyramid.

Key Issues Identified

During the consultative workshops, in Bengaluru and Mumbai, the issues and barriers as well as the risks inherent in enabling nanotechnology for water purification to reach the BoP were largely discussed. Some of the issues identified are as follows:

- Nanotechnology is still a nascent science. There isn't enough **understanding or agreement on impacts on health and environment.** Even among the research community, there is no obvious sharing of experiences and findings.

- There is **huge disconnect between researchers and industry**. This leads to innovation remaining in papers and not seeing the light of day

- **Incubators or Technologists,** who connect a proven technology to its field application, are **missing.**

- **Lack of awareness** is a major barrier to large scale penetration of water purification practices in the BoP population. There is a lack of information available to the community on understanding the status and threats posed to and by their common property resources like water.

- **Logistic reach to the BoP populations** needs to be improved in terms of supply, disposal mechanisms as well as servicing and maintenance. Lack of reach is another major barrier to dissemination of benefits

- **Prohibitively high costs** prevent the technology from reaching the BoP populations. There is a potential to lower costs by tweaking production and distribution systems.

- There is **policy gap in terms of monitoring, production and application of nanotechnology based devices**. There is no regulation targeted at Nanomaterials presently. During the Risk Mapping exercises, maximum risk was perceived during production and disposal.

Consultation Summary

The consultation was designed to build on the identified issues and learnings from previous consultative workshops. While the technical aspects of the available nanotechnologies, risk assessment and market and policy barriers were discussed at the previous consultations, this workshop focused on strategies to surpass these barriers and risks. Successful models of nanotechnology that had reached the market and solutions to improve access to the BoP population were the focus of this consultation. The participants were a group of sectoral experts including technology researchers, development sector professionals, Industry leaders and manufacturers who enabled a multifaceted discussion on the topic.

Dr Sanjay Bajpai, DST

The day was divided into three important sessions that were preceded by a comprehensive introduction. Two introductory presentations set the tone for the workshop – the first by **Dr Sanjay Bajpai** from **DST** who highlighted the scarcity of water among BoP populations and some of the Research and Development initiatives in the field of nanotechnology that address the issue of water purification. The second presentation by **Dr K. Vijaya Lakshmi, DA** put forth the findings and identified issues from previous workshops and the important questions and outcomes that needed to be worked towards during the course of the workshop.

The first session was **Nanotechnology: Opportunities and Challenges. Dr. Paknikar** of the nanobioscience division from **Agharkar Research Institute** gave a presentation on the topic. He first demonstrated the various problems that the country's water faces today and then outlined the various functional categories of nanotechnology to address these problems with examples of technologies in the incubation, development and market phase. This was followed by an interesting discussion on the potential for nano technology to be commercialised and up-scaled, the need for water purification among BoP population and agreement between participants that the technology should be used to address priorities rather than be abused.

The second session of the consultation was on **Market Potential and Service Delivery Models** of Nanotechnology for safe water. Dr. Prateep Roy, of Grasp Analytique presented some of his findings from a market survey conducted among both urban and rural BoP populations. This was followed by a presentation by Dr. Tata Narsinga Rao from the International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI) who has successfully applied silver nano particles to the ceramic coated candle filters extensively used in the country, this is a low cost model that has increased the effectiveness and life of the candles and has immense potential to benefit BoP populations. During this session, focus was laid on the industries present – Eureka Forbes, Thermax and Tata Chemicals to hear about their experiences in productizing available technologies and reaching BoP markets.

The Workshop brought together stakeholders from diverse fields

The third and concluding session was on **Role of Stakeholders** and consisted of the participants breaking up into groups based on their expertise and working on different themes. The themes covered were **potential of nanotech to reach BoP for access to safe water (**including the potential for traditional practice to be combined with nanotechnology), **how to ensure that existing technology and products reach the BoP market**, **a risk assessment of nanotechnology** and **systems and processes to implement a Public Private Community Partnership (PPCP) model.**

The proceedings, highlights from presentations and questions raised are detailed in the sections below.

Introduction to the Workshop

The workshop was initiated with a round of introductions that brought to light the presence of a diverse range of stakeholders including government, industry, non-governmental organisations, bilaterals and multidisciplinary research institutions. During the introductions, participants made their area of expertise and their expectations from the workshop known.

The opening remarks were given by **Dr. Sanjay Bajpai**, who leads the Water Technology Initiative of the Department of Science and Technology (**DST**), by way of a presentation. It outlined the basic scarcity of water among the BoP populations with statistics that proved that **per capita availability of water among poor people in the country is low – even in urban areas.** Other crucial areas of focus for safe water included the requirement for decentralized water quality treatment, the need to improve water availability through water reclamation/reuse, the need for sustainable intensification of irrigation and the need for efficient and effective planning of urban water systems.

The presentation then outlined some of the Research and Development initiatives in the field of nanotechnology that address the issue of water purification. These included the use of nanotechnology for detection of contaminants as well as removal by entrapment, degradation and separation. Some interesting technologies that have been commercialised included a venture by IIT Madras and Eureka Forbes for the removal of pesticides using silver nanoparticles and nanosilver coated ceramic candles for drinking water developed by ARCI. The need to **focus on application and product based research and innovation** was also put forth. For instance, innovation needs to address new and emerging issues such as increasing salinisation in water especially in landlocked areas. The presentation concluded by stating that the **need of the day is technologies that meet technical, social, economic and environmental considerations**.

An introductory presentation was then given by **Dr K. Vijaya Lakshmi** of **Development Alternatives** (DA). The presentation outlined the background and context for the workshop. It also highlighted the urgency of the issue (safe water for BoP) and the role of DA in addressing the issue through innovation. She mentioned that since conventional methods were not working effectively, **nanotechnology could be looked at to provide**

solutions for both purification and detection. She also highlighted the findings from previous workshops held in Bangalore and Mumbai for the benefit of the attending participants. It put forth the barriers identified both in terms of reaching BoP markets as well as in taking nano technology forward. Finally, it put forth a series of questions that needed to be actively addressed during the course of the workshop examples of which are given below:

- What should be our strategic responses for technology uptake by BOP and Governments, development agencies and other institutions?
- What are the required Processes/ Systems/ Policies needed to mange the associated risks?
- What are the institutional models needed to ensure quality of service delivery and address issues of governance and gender issues? What kind of support systems are needed to safeguard the sustainability issues?

Dr. K. Vijaya Lakshmi (DA) putting things in context

Session I: Nanotechnology: Opportunities and Challenges

The session was defined by a presentation from **Dr. Paknikar** from the centre for nanobioscience at the **Agharkar Research Institute (ARI).** Speaking from his personal experience, Dr Paknikar stated that in the case of nanotechnology it is important to separate fact from fiction and hype from hope because currently the anticipation and expectations from nanotechnology are immense.

Dr K M Paknikar, ARI

Addressing the issue of water he stated that our water is undoubtedly unsafe considering the presence of pathogenic micro-organisms that cause myriad waterborne diseases, toxins produced by aquatic algae and bacteria that can also cause health issues, chemical constituents such as chloride and magnesium that create a risk of dehydration as well as fluoride, arsenic, heavy metals and pesticides.

He outlined the potential of nanotechnology based methods for water purification through the four functional categories of Nanomaterials. These are:

- Nanomaterials as sorbents, used for the removal of heavy metals and inorganic contaminants
- Nanomaterials as filtering agents, used for removal of contamination by filtration
- Nanomaterials as catalysts, used for removal of pesticides and other organic matter including toxins
- Nanoparticles as antimicrobial agents for water disinfection, used for killing of disease causing bacteria, viruses and protozoa.

Of these, he stated that **nanocatalysis** is going to emerge as an important area and that silver nanoparticles had immense potential because it is difficult to build resistance against silver.

He also mentioned a technology developed by ARI where *E.coli* bacteria could be detected on a strip, the detection at this stage is qualitative but could be made semi quantitative and takes 20 minutes. He concluded by suggesting that perhaps a opening

to BoP markets could come by way of a personal water treatment system – a PET bottle that would use sunlight and nano material coating that kills bacteria, viruses and protozoa as well as a coating that destroys organic and inorganic contaminants.

A loaded discussion followed the presentation. This included a criticism of nanotechnology since it had failed to provide any solutions for large scale water supply systems. For instance Dr. K. J. Nath, Member of National Ganga River Basin Authority and Chairman, Arsenic Task Force, Govt. of West Bengal mentioned that no proposals from the nanotechnology field were received when proposals were called for an intensive programme to clean up the Ganga as well as a programme in West Bengal where all villages would received purified pipe water, and therefore, to him the scaling up and commercialization of nanotechnology was doubtful. This criticism was countered by researchers stating that commercialization at such as scale could not be expected at such an early stage, and nor should doubts cloud the uptake of nanotechnology, which is being focused on to provide efficient and affordable solutions.

One opinion expressed was that the pro poor approach, when it came to water purification, was absent in the country, therefore the energy intensive method of reverse osmosis (RO) was most widespread. It was also pointed out that in the West, systems for waste water treatment were already in place, however in India this was not the case and thus methods of water purification were widely discussed. On the other hand, in some cases there was a need for better management of water rather than a need for purification.

The opinion that technology should not be abused was agreed upon by all participants. It was stated that issues such as the management of sanitation systems and industrial effluents need to be taken care of rather than cleaning the water after the damage was done.

The Department of Science and Technology had conducted a survey in 168 locations where 50% of people stated that water purification is the major issues. Thus it was apparent that water purification was still a crucial issue that needed to be addressed. Additionally nanotechnology, like all other technologies requires to be validated on the following criteria – **Market readiness, cost of water, reject management and stand alone application.**

A few other technological developments were discussed, such as a straw used by the US army, that purified water to the extent that you can safely drink from a drain. Dr. Narsinga Rao mentioned a technology developed by ARCI where E.coli bacteria could be detected on a strip, the detection at this stage is qualitative but could be made semi quantitative and takes 20 minutes.

Participants viewing the presentations

Session II: Market potential & Service Delivery Models

The second session began with a presentation by **Dr. Prateep Ro**y, director of **Grasp Analytique**, consisting of his relevant findings from a recent market survey he conducted in the rural and urban BoP markets regarding water filters. He stated that awareness levels on water impurities amongst the rural and urban poor were low. Their sole criterion used to evaluate their water was dirt (turbidity). He also found that the while the BoP had knowledge of traditional methods like boiling, putting a cloth on the tap, multi layer purification, these too were infrequently practiced.

His survey findings were that 6% of his sample was using purifiers; users from urban areas contributed more to this figure than users from rural areas. The survey, that also covered retailers, revealed that the stocking of non electric purifiers was most popular since these also sold the most. The major barrier to the use of water purifiers was price; additionally his survey revealed that there was very low knowledge about existing purifiers in the market, and a lack of understanding as to how water was cleared of its impurities.

Following the presentation it was commented that awareness about impurities was so low because centres for water testing were very rare in the country. Additionally getting water tested from an institute was an expensive affair. In the country, the conviction that drinking tap water increases immunity is present even among the educated.

A second presentation was given by **Dr. Tata Narsinga Rao**, from the **International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI)** that covered the application oriented research done by the institute. Talking about the nanosilver coated Ceramic Candle Filters, he stated that a lot of people depend on these filters because they remove turbidity – but by adding nanosilver into the same material, water is also being disinfected from bacteria, providing a low cost and convenient solution. The only disadvantage is that chemicals, if present, remain.

He stated that scientists should be socially responsible since with **great power comes great responsibility**. While potential leapfrogging opportunities for silver nano exist, which is now being used in cosmetics, sports equipment, textiles etc., the **regulatory mechanisms** in India are **missing**. For instance, a washing machine that is banned in

America which releases silver nanoparticles into ground water killing all bacteria, even those necessary for fermentation, is available in India.

His presentation also commented on the issue of awareness among BoP commenting on the use of ceramic candles. Among the BoP, the awareness that ceramic candles are good only for the purification of surface water and not ground water, that may have chemical contamination, is absent. Additionally they are sometimes not aware that once they have candle filters they need to boil the candles once a month since the candles are porous and with time bacteria that gets trapped in the pores grows exponentially and thus the water is not safe. These issues have been taken into account while designing their nanosilver coated candle, for which a complete life cycle analysis has been done. The candle contains .5 grams of silver and the reject is below 0.1 mg/litre which is below the limit allowed by the World Health Organisation (WHO).

The only drawback being faced by Puritech, the small company marketing the candle, is an inability to penetrate the market because of lack of awareness among the community.

Dr. Rao also spoke about an interesting technology being developed that could promote water conservation – cotton with silver nano particles that can remove stains, sweat etc. when used making it possible to wear the same clothes a few times rather than washing it.

Following the presentation, a moderated discussion took place, focusing on the opinions of the Industry. A representative from **Thermax** stated that in the organizations experience of working with water for 40 years, the water sector has been a government area. Additionally, he stated that each area is unique and has its own problems for instance distance from clean water, type of contamination etc. what makes it difficult to penetrate the markets.

A representative from **TATA Chemicals** spoke about the low cost Tata Swach which came at 3 different prices – ` 499, ` 699, and `999, with a purification cost per litre of 10 paisa. This filter also used silver nano particles to purify water, which he stated keeps water free of bacteria for longer periods of time. He said that TATA was concerned about the community and taking into account awareness levels in the population had designed the Swach to stop working once it had reached its purification capacity- i.e. when the filter needed to be changed. This enabled TATA to replace the filter when required as

well as safely dispose of the older one. Swach confines to all the international standards, since no standards in India have been defined as yet.

Eureka Forbes has dominated Indian markets with their RO and UV based water purifiers. However, the representative from the organization also spoke about their introduction of a filter in West Bengal to remove arsenic and a Nanotechnology solution to remove pesticides from water in collaboration with IIT Chennai. However, he commented on the huge gap between researchers and industries, since information about the technology that IIT had developed was got by chance, through a published paper. He stated that the application of nanotechnology to the final product was a long journey that had taken 4 years. Additionally, before introducing the model its impacts on health and environment had to be assessed and legal implications taken care of. For this product they are putting in place mechanisms where new products will be given in place of the old one to ensure safe disposal.

Speaking to the participants, particularly to representatives of research institutions, he stated that as an industry – the first condition for taking a technology on board is **cost**, however he admitted that **performance** is perhaps more important, factors such as what is its ability to mitigate bacteria, chemicals etc. **Health** and **environmental impacts** are also considered and the **service life** (minimum 1 year) since it is difficult to service products often in BoP markets. The final consideration is the **shelf life** – the duration for which it can be safely stored at the retailers.

To a query about Intellectual Property Rights, it was stated that the research institution (IIT Madras) has rights to the technology, once the technology was productized, joint rights were held for the product (IIT Madras and Eureka Forbes).

To be able to attain success in BoP markets, it was stated that providing a low cost service requires a lot of information from the Govt. of India. Considering the gap between researchers and industry, questions were raised as to how the Department of Science and Technology (DST) was bridging the gap. **Dr. Asthana**, who heads the nano mission of DST, stated that as a funding organization, DST supported a lot of good academic research, however for this to translate into a product takes time; however the industry requirement is to have the product ready as soon as possible. The government started nano at the same time as the rest of the world but started small and with no characterization facilities. From 2007 onwards investments have gone up and India has

emerged on the nanoscience top 10 (7th) among the top 10 publishing nations of the world. While the **Nanoscience aspect is doing well**, the science to technology link has been traditionally weak in the country since Indians are not comfortable with the idea that knowledge can generate money.

An important learning, shared by DST, came from **loans** given previously to **industry** which were not successful. Dr. Asthana felt this was because of an absence of financial institutions with the ability to manage the loans given out. However, the government is now coming up with workable models to give out grants for application and product development, this information is available on their website. Additionally, they are providing support for technologies from the lab to reach the prototype scale through the set up of a technology development board.

To a query about the protocols in place for up scaling technology, Dr. Asthana mentioned that most progress by the industries has taken place in point of use treatment. However **point of entry treatment** also needs to be looked at and translated to the **village level**.

An important point raised was that while technology needs to continuously make progress to deal with emerging issues, examples of successful sustainable marketing strategies can be emulated. The example of such a model by the March project was given with the suggestion that collaborations with such projects can take place.

Session III: Role of Stakeholders

In this final session, it was proposed that the participants divide them selves into groups to come up with strategies and methods to bring safe water to the BoP markets. However, a suggestion to have groups work on different areas, taking into consideration the presence of experts from various areas, was accepted from a participant and the following themes were decided in an interactive manner:

- Group 1 - Scientific potential of nanotechnology to reach the BoP for access to safe water, Integration of traditional practice with nanotechnology –Led by Dr. Yakhmi
- Group 2 – How do you ensure existing products reach the BoP market? – Led by EFL Dr. Abhay Kumar
- Group 3 – Risk assessment and management for nanotechnology – Led by Dr. Alok Dhawan, Indian Institute of Toxicology Research (IITR)
- Group 4 – What systems and processes are needed to implement a Public Private Community Partnership (PPCP) model – Led by DST Dr. Bajpai/ Dr Manavalan, AFPRO

Each group was given 1 hour to discuss the theme, and 10 – 15 minutes each to present points from their discussion and recommendations.

Scientific potential of nanotech to reach BoP for access to safe water and Integration of traditional practice with nanotechnology

The first group focused on the technologies that are in the market or at the development stage that have the greatest feasibility to be developed in the next 5 years as well as the potential to reach and benefit the BoP market. They put forward the following options taking

Q & A

Q: What are the negative aspects of these technologies?

A: Silver being a noble metal is essentially known to be the least harmful

Q: How do you address genotoxicity?

A: Size of pores and skin can be larger than nanoparticles; we are working at levels that can't leach out.

Q: What is the nanoparticle size used

A: There is a window most applicable to the technology; therefore the size used depends on the technology

into consideration the multidisciplinary nature of nano science and technology:

- Purification System (**Candle**) with coating of **silver nano**; the technology, which is already available, will ensure removal of microbial and physical contaminants
- A **family size Pet Bottle** (5 litres) coated with a mix of materials and coupled with a coarse filter to take care of several contaminants, this would be an ideal technology that has the feasibility to be developed
- **Nanoporous Polymer membrane** for **TDS** Removal was also envisaged; This is possible currently through Reverse Osmosis (RO)
- A **Rapid Testing Kit** for microbial and other Impurities which is under development
- **Nanoporous Polymer Membrane** enabled **Arsenic** and **Fluoride** removal, that will prove extremely useful in the country considering the extent of Flurosis and Arsenic contamination

Ensuring existing technology and products reach the BoP market

In this presentation, the group first outlined some of the barriers present in making nanotechnology products reach the BoP and then presented ways to facilitate the process and break some of the barriers.

Dr. Abhay Kumar, EFL presents the results of his group exercise

The issues mentioned were as follows:

- **Realisation of Demand**: The group felt that demand for safe water is absent among BoP markets due to factors such as lack of awareness and lack of finances; it was felt that clean water is very low on the list of priorities among BoP
- The current set up of **service**, **maintenance** and **transportation** was also felt to be **inadequate** to reach the BoP populations

- It was felt that **identification of the correct technology** was extremely important, for instance it was felt that between a community set up and point of use purifiers the latter may have a more sustainable advantage because of a feeling of ownership among the user(s).

The group proposed that the solution to reduce these problems was a localization of production. The details put forth were:

- The use of **Self Help Groups** (SHGs) in rural areas, who will assemble and sell the products
- The active engagement of industries with NGOs, if they are not directly willing to engage with the SHGs. NGOs can enable successful monitoring and management of the SHGs.
- Emulating successful examples where SHGs have used **microfinance** to buy expensive products

Q & A

Q: Have any of these suggestions been applied in the field

A: The use of SHG's in assembling and distributing water purifiers is a successful model that Eureka Forbes has implemented

Suggestions

1) While focusing on BoP, focus should also be placed on slum populations in urban areas
2) Training and Capacity building needs to be considered for the SHG's that can be undertaken by the NGO's or industry representative since not all SHG's are empowered.

- **Convergence** with the Accredited Social Health Activist (**ASHA**) can be sought. These are community based functionaries part of the rural health mission of the government and could prove immensely useful in creating awareness about the hazards of contaminated water and benefits of safe water.
- In terms of marketing the product, two valuable suggestions were put forth. One is the need to create an **emotional connect** with the product; for instance how it could lead to healthier children. The other was the need to research and put forth the **value proposition**; for instance the use of a filter will save money in the long term in terms of medical costs, man days etc.

Risk Assessment of Nanotechnologies

The third group initiated their presentation by stating that generally **risk assessment** is at the **back burner** – mainly because of **economics**, the hassle of risks takes a backseat. While nanotechnology has taken great strides in reaching the markets, the evaluation of risks at all stages and regulatory mechanisms in the country are still at a nascent stage. The group put forward a series of steps that need to be put in place for better management of risk with regard to nanotechnologies:

Dr. Alok Dhawan, IITR on the gaps in regulation & risk analysis

- Mechanisms to **monitor** the **risks**, as well as monitor the **rules** and **regulation** for nanotechnology need to be implemented
- The **regulatory** mechanisms for **research** and **production** of nanotechnology based products needs to be strengthened
- During **technology transfer**, it is the duty of the person/ institution transferring the technology to make the industry/user aware of the risk factors such as **laboratory requirements, management** and **disposal practices**. This will generate confidence among manufacturers and end users.
- The **industry** needs to concern itself with addressing the risk. There are examples from China and Europe where people have been harmed and died from application and exposure to nanotechnology
- The risk of products coming out of the market needs to be analysed on a **case to case basis**
- Products that does not pass the **Quality Assurance** stage should be **disposed properly**

- **We need not become guinea pigs of technology**, Nanotechnology needs to slow down until its risks are fully known. Lessons can be learnt from the overuse of pesticides, residues of which have been found in the arctic. For instance we need to consider priority areas for the application of nanotechnology, not all water needs to be purified; small units of water can be purified while the rest can remain grey water as is the case in the water management system of some high rise buildings.

- **Hazard Analysis** for nanoparticles needs to be done; systems for the disposal of hazardous materials also need to be in place. For instance how do you address the risks while transporting these materials – **what happens if there is an accident?**

- **Guidelines** for handling nanoparticles should be **accessible** to those who need them and products using nanotechnology should have a labelling system to certify that they are safe.

Q & A

Q: Are there any projects addressing the hazards of nanotechnology?

A: There are not too many groups who are studying the toxicological aspects of nanotechnologies, however the DST is proceeding with a survey of what exists internationally as well as promoting more toxicological research to generate data which is authentic and working towards making nanotechnology standards more effective. In time DST will have a regulatory framework

Suggestion

While all regulation needs to be based on science; other tools such as life cycle analysis, environment impact assessment, software etc can also be used for a more holistic approach

Systems and processes to implement a Public Private Community Partnership (PPCP) model

The group came up with a workable PPCP model. The model would consist of 20 villages that would be provided with safe drinking water, the infrastructure of which would be operated and maintained by the community itself. To enable this model first the following will have to be done:

- Selection of District
- Government would provide the infrastructure and water source
- Single Window System

- Identification of Water Bodies
- Autonomous bodies as neutral bodies

The backbone of the model will be the **participatory approach** initiated with a stakeholder consultation and need assessment. The community, district level officials, product developer, financial institutions, CSO/ CBO's– all need to be consulted before developing the model. The stakeholder consultation should reveal what model needs to come into place to based on the existing issues – health/ water contamination etc. The need assessment is required to pin point the requirements of awareness generation related to water quality and extent of **capacity building** required before the activity is started. In such a model the inclusion of district authorities is also important – information of village infrastructure, water bodies, and available funds is crucial.

Dr. Manavalan, AFPRO on the PPCP Model

Conclusion

The workshop provided a useful platform for stakeholder interaction and interdisciplinary learning. **Partnerships between research institutions were established and links between industry and research institutions strengthened.** Rather than enlarge on the technical aspects of the technology, the workshop focused on the existing partnerships between research institutions and industry that had enabled low cost water purification systems to reach the market and potential technologies in the development stage that had similar feasibility.

It was established that **nanotechnology can provide feasible solutions to the BoP both in terms of purification and detection**. Progress is being made in both these aspects to address some of the **widespread contaminants that make water unfit to drink such as bacteria, fluoride, arsenic, pesticides and increasing salinity**.

While DST ensured the participants that steps were been taken to ensure more toxicological research and put regulations in place for the use of nanotechnologies, the **workshop threw light on several gaps that remained in ensuring nanotechnology does not harm human and environmental health.** For instance, a washing machine that releases nanosilver into drains that has been banned in USA is still available in India. However institutions stated that considerable research on the health and environmental impacts is done to make the technology and products conform to international standards in the absence of any India specific ones.

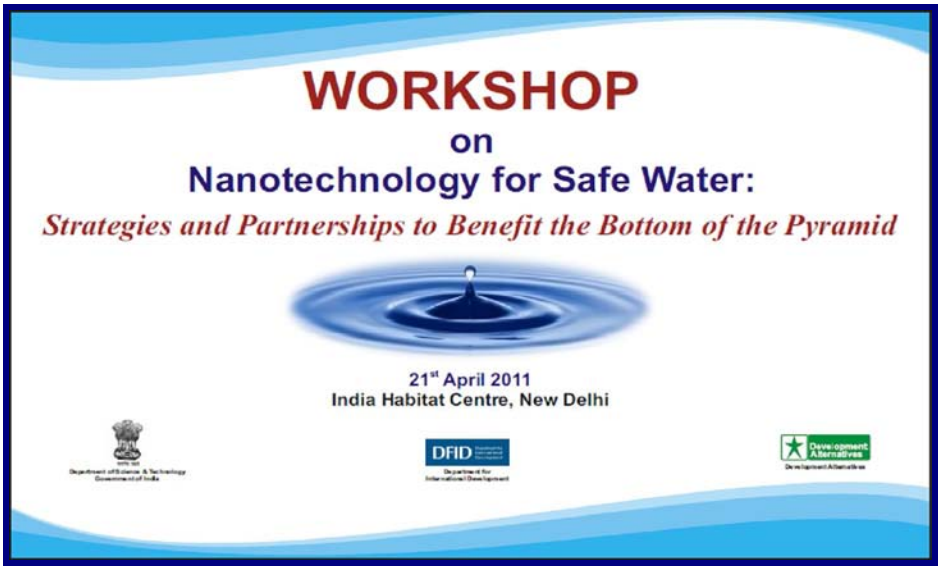
Other valuable inputs were the **need to necessarily undertake a life cycle analysis of products to determine their risk during all stages such as production, transportation, use and disposal**.

While it was agreed that water needed to be made safe **there was consensus that technology should not be abused**. It was stated that waste water and sanitation management and practices needed to be put in place that avoided contamination in the first place rather than focusing on cleaning all the water. Thus **the use of nanotechnology in terms of personal and small scale water purification and detection systems was the focus of discussions and found more feasible** at this stage.

A discussion that emerged repeatedly in the workshop was the **need to localize processes for technology to benefit the bottom of the pyramid.** It was felt that **more application based research that focuses on the region specific problems of the BoP is required.** Additionally, there was agreement between all participants that **localized institutions such as CSO's, CBO's, SHG's, PRI's and district level government officials can pay a crucial role in reducing the barriers that prevent access to BoP** markets.

The concluding remarks to the workshop were given by Dr. K. Vijaya Lakshmi who stated that the learnings from the consultation would be taken forward to a potential phase II DFID action research programme. This would involve the experts in multi stakeholder processes to evaluate and pilot feasible approaches to enable nanotechnology to reach the BOP. The results of this action research would be widely shared and disseminated.

Dr. Vijay Lakshmi thanked DFID for the opportunity to work on an emerging technology that could have a significant impact on the poor, the Department of Science and Technology (DST) and Dr. Praveer Asthana, Dr. Sanjay Bajpai and Dr. Prasada Raju in particular for their continuous guidance and support, Rakesh Khanna of TARAhaat for moderating the consultations efficiently and all the participants for their valuable and expert inputs.



Workshop on Nanotechnology for Safe Water

Annexure

i. Agenda

ii. List of Participants

iii. Presentations