
Technical Session III

**Business Opportunities for Women
Scientists and Engineers**

BUSINESS OPPORTUNITIES FOR WOMEN SCIENTISTS AND ENGINEERS

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INTRODUCTION

Women are making important contributions in all walks of life including science and technology. While in the past, there has been more enrolment of girls in pure sciences, in recent years, more and more girl students are taking up engineering courses. Another interesting observation is that two-thirds of the working women scientists and technologists are engaged in the teaching profession. This can be attributed to the fact that in our country, women still do the traditional role of "home makers" and a teaching career enables them to do an ideal balancing act between serving both work and family needs. However, the scenario is fast changing and the boundaries between the traditional sex roles are slowly disappearing, which helps to blur the distinction between the values of men and women. This has had profound effect on the options available for women in the field of education and choice of occupation. The environment is also conducive for women to turn into entrepreneurs owing to the several woman-friendly schemes in operation, be it from financial institutions or from governmental agencies. In this context, it would be worthwhile to examine the potential of women as entrepreneurs as well as the possible avenues available.

WHY WOMEN CAN BECOME SUCCESSFUL ENTREPRENEURS

Technological development paves the way for new methods of establishing an enterprise. This would entail new organizational systems and new forms of management. In this connection, women have several qualifications and values that would enable them to meet the demands of entrepreneurship. To be a successful entrepreneur, one has to be a good manager too. Several surveys conducted in different parts of the world have shown that women are good managers for the following reasons:

- They are good at motivating and creating job satisfaction
- They can formulate their thoughts better
- They are better listeners (lend a sympathetic ear)
- They are extremely good at coaching
- They have leadership potential.

There is therefore ample evidence to suggest that if more women are motivated and are given the necessary tools for becoming entrepreneurs, they would contribute effectively in running viable commercial enterprises.

BIOTECHNOLOGY AS A RESOURCEFUL AREA FOR ENTREPRENEURSHIP

Biology has been a field of science that has always attracted girl students. During the past four

decades, tremendous advances have been made in biological research, as a result of which new and hitherto unimagined products and processes have now been introduced. The field of biotechnology has revolutionized industrial growth all over the world. Armed with the powerful tools of biotechnology, a lot of innovations are now possible in agriculture, food, health, industry and environment sectors. A number of avenues have opened up for commercialization of the technologies developed. In the area of medical health, interesting products like new generation vaccines and diagnostic kits for diseases are available and many more are likely to be developed. In the field of food technology, production of enzymes required by the food industry is a viable commercial proposition. In the area of agricultural biotechnology, several business opportunities are available both in terms of production of biotechnological products as well as providing diagnostic services. Some of the avenues in agricultural biotechnology are detailed below.

ENTREPRENEURSHIP IN AGRICULTURAL BIOTECHNOLOGY

Products: A host of proven technologies are now in place in the field of agricultural biotechnology, some of which have been commercialized. Micropropagation of plant materials has emerged as one of the time-tested commercial activities. Women scientists can take up this area as a commercial venture. Biotechnologies and biopesticides are another class of biotechnological products that can be taken up for large-scale production. With the current emphasis on eco friendly substitutes for chemical fertilizers and pesticides, the demand for biofertilizers and biopesticides will be on the increase. Hence, one can perceive a tremendous scope for such a commercial activity.

Services: Establishment of diagnostic laboratories in agricultural biotechnology, akin to medical diagnostic laboratories, is a relatively new field of activity. There are essential two aspects in which diagnostic services could be provided. One is on DNA fingerprinting and the other is disease diagnostics.

DNA fingerprinting for varietal identification in plants has assumed a lot of importance in the country in the wake of the Plant Variety Protection Bill being passed by the Parliament. One could envisage an enormous demand for this service from the private seed industry. Services could be provided in two ways. In one case, fingerprints could be generated for individual crops and the clients could be charged on a per sample basis. The other method would be to develop need-based DNA markers on an exclusive basis and charge as a total project cost.

Detection and identification of pathogens at an early stage is critical in the successful production of a crop. This is more so in the case of virus diseases where the extent of loss could be as high as 90 %. Unlike in medical diagnostics, disease diagnostics in plants using sensitive detection kits is still in early stages. Hence, there are immense opportunities in this area not only for providing diagnostic services but also developing such kits and marketing them.

CONCLUSIONS

Any business venture can succeed only if the right environment is provided. In the case of entrepreneurship in biotechnology, the Government of India and several State Governments

have shown a firm commitment to the development of biotechnology industry. Several states have established biotechnology parks. A novel initiative by the Department of Biotechnology, GOI, is the establishment of a Biotechnology park for women in Chennai. Moreover, in our country, women entrepreneurs have always been encouraged in terms of financial support and other benefits. Hence, the time is indeed opportune for more and more women scientists to channelise their expertise, knowledge and skills into business ventures. The success stories of many women entrepreneurs like Ms. Kiran Majumdar-Shaw should motivate several others to take the plunge and become entrepreneurs. In the final analysis, women should have both inner and outer empowerment. Inner empowerment refers to women being comfortable with themselves and their careers, feeling valued and effective and holding an empowered attitude. Outer empowerment is to be provided by external factors starting from the family to other external agencies. The vast untapped potential of "Sthree Shakti" can thus be put to use for the benefit of mankind.

BUSINESS OPPORTUNITIES FOR WOMEN SCIENTISTS AND ENGINEERS

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Today, more and more women are stepping out of their homes to earn a living, make a career and establish their own identity. And never before have so many opportunities been available to women. A measure of success in the outside world goes a long way in building a positive self - image. This can come through the profession or vocation or through creative talents. Every person has a facet an interest a talent or ability that can be developed. Even a hobby can be projected as to add an important dimension to the personality. It can help to open up a whole new world. There are hundreds of options that can be most challenging and fulfilling from computers, designs, jewelry designing and manufacturing, biotechnology and many others.

It is being recognized belatedly that women, who have naturally higher emotional intelligence, i.e. EQ, make better managers than men. Now it seems that women with children are the best of the lot. Juggling nappies and nannies, and negotiating with whining children is enough to prepare any women for senior management. And if any women is a scientist, it is all the more better as she is more systematic and used to organizing and managing in various fields, and can manage in a better way.

Unlike the early decades of 20th century, when women were largely employed in teaching and nursing, today women scientists are seen in the higher echelons of all professions. Still, medicine attracts them the most as many families prefer that women should consult and be treated by female doctors. Since family physicians have fixed consultancy hours and few late hour house visits because of use of mobile phones and landlines, women also work as general practitioners.

Any numbers of business opportunities are open for women scientists and technologists as for any other women. Some women come into business in the field of their specialization like opening nursing homes. Some make a choice in the field they never would have thought they would venture into. Many of the women scientists become home entrepreneurs or opt for flexi-jobs as this gives them the freedom to work at their own pace to a more customized time schedule with the skills they possess or can acquire. Thus catering, garment designing, confectionery connoisseurs, beauty therapists, school management constitute some the favorite vocation of women who are looking to make some money in their free time. Yet others take on part time jobs and assignments pursued from their homes.

Since business opportunities for women are limitless and to list them all would mean more pages than a John Grisham novel, here are profiles of some women scientist entrepreneurs and pioneers serving as examples of the countless business opportunities available.

Neena Kanwar- The Queen of Hearts

B.Sc. from the University of Toronto and a specialist degree from the Toronto Institute Of Medical Technology, Division Of Nuclear Medicine Toronto, she started out her career as a temporary

nuclear medical technologist. In 1988 she founded KMH-Cardiology and Diagnostic centers, providing medical services and technology with the aim to offer quality diagnostic procedures and assist physicians. She is currently the president and founder of the International Heart Inst., since 1996, specializing in cardiac risk management and prevention. Today KMH has 77 centers across Ontario - no mere feat given the challenges Neena has faced. She is the recipient of the Nuclear Medicine Award for an essay; recently she has been honored as the Canadian Women Entrepreneur of the year in the start-up category for her companies and has also been voted the 2001 Businesswoman of the year.

Taab Siddiqi - Harvesting Gold

Taab, wife of Adil Hassan - an IIT Delhi Chemical Engg., wanted to become a doctor. She studied science at Our Lady of Fatima School, Aligarh and then decided to pursue Chem. Hons at the Women's College. Her parents convinced her not to pursue her doctor degree as the hours would be bad and would result in no family life. Therefore she decided to pursue an MBA in finance and marketing from AMU's Faculty of Management Studies. Today she has created Harvest Gold, the label that accounts for 95% of the bread consumed in Delhi. She heads a 50 Crore (and growing!) business that employs 400 people and supplies over 1,50,000 loaves/day.

Dr Jasbir Cheema - Distributing Fame

After a 13-year stint as residing doctor at Army Public School, Dhaula Kuan, she joined Tupperware as a distributor. She got the Hall of Fame trophy for the year 2000 being supervisor of around 2000 dealers and she is still expanding her already vast area of operation.

V Arunakumari - Lens Master

Camera Lenses are quite complex and require a delicate hand, only few possess to clean and repair them. Enter V Arunakumari. She is the first Indian woman to have been trained at the Carl Zeiss Co. in Germany, home to some of the best lenses in the world. Now she repairs lenses at Kamal Cine Services.

Dr. Rupal S. Shah - Woman with a vision.

Dr. Shah is an ophthalmologist and has a vision of helping people get rid of their spectacles and lenses. Her husband, a chemical engineer has helped her achieve her objective. They have set up 7 Vision correction centers at Mumbai, Vadodara, Ahmedabad, Rajkot, Udaipur, Surat and Hyderabad. She has also set up six cosmetic laser centers for the removal of unwanted hair using laser technique. Besides being a mother of 2, Rupal is a traveling surgeon and operates in about 8 cities. She also trains ophthalmologists at various centers outside Vadodera, where she is based.

Rita Kathuria - Tailoring Success

She has shown that embroidery needn't only be a hobby. The skill in fact can be turned into a good business for a homemaker and corporate wife. She is a science graduate and always enjoyed attending cookery classes or painting on fabric. She did her M.A. in Political Sc. from Agra

University. She wasn't trained to be a fashion designer but her extraordinary embroidery skills have made her the favorite of some of the top names of the industry. She started out ten years ago with some assistants, but today Rita has over 20 people under her. Her business picked up by word of mouth and now she is supplying to upmarket stores like Taj Khazana, Paddakam in Santushti and Khan Market apart from catering to NRIs and wedding.

Vanita Suhasini - Castle of furniture.

Vanita holds a masters degree in physics and assists her management consultant husband Arun Srivastav. She did her MBA from the Univ. of Aston Birmingham UK, as she thought that with a management degree she would be better equipped to do 'something' for society. More than a decade later, Vanita is supervising trainees at 'Castlewood' her furniture factory. Among the apprentices are two young men from Salaam Ballak Trust (SBT), which was set up by Mira Nair (renowned filmmaker) for street children. They are paid trainee allowances and once they prove their mettle, they can either be absorbed full time or seek better prospects elsewhere. Then two others will take their place. Having started Castlewood two years ago, Vanita is determined to ensure that her worker's welfare does not suffer in anyway. She says, She wants to make an Infosys of Castlewood. It may be small but for her workers it is their Infosys. (Reference is being made to the Bangalore IT giant)

Dr. Neeru Dhingra - High on Health

Originally a fitness consultant and personal trainer in Chicago for the last five years, she is in Delhi with the purpose of making everyone fit and healthy. She has a degree in sports medicine from Harvard and she has moved from curative to preventive medicine. She moved from Chicago to Delhi and opened her own company - Neeru Dhingra Fitness Consultants (NDFC) that consults with health clubs and personal training. She manages several health clubs and is a regular writer on health matters and is writing a book on fitness.

Chitra Goyal and Meenakshi Shah - The Dynamic Duo

Both are graduates in Chemistry and MBAs majoring in marketing and worked in the corporate sector. Then they left their mundane 9 to 5 jobs and setup their own venture. They run a stained glass and wrought iron concern - Art Advent, supplying to some of the best-known stores in Delhi and Noida.

Kiran Mazumdar - Bio-Connoisseur

The Bangalorean is the CEO of the Biocon, India Group. She is India's first lady to be trained as Lady Brew master at Melbourne Univ. in 1975. Now she heads India's leading biotech enterprise which produces health care molecules, Industrial enzymes, drug intermediates, food ingredients and process aids.

FOOD PROCESSING TECHNOLOGIES FOR WOMEN ENTREPRENEURS

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INTRODUCTION

Women's control over food processing is as old as history. In a predominantly agricultural economy food processing has been an integral part of daily life and essential part of dietary needs. The processing enables longer storage of food materials and, transportation, packaging, distribution to the retail trade in scattered out lets. Women in rural areas as well as in urban settings have been responsible for developing food habits and diversify them to suit the changing life styles. Thus, food processing techniques developed and progressed under women's care as house hold sector over centuries.

WOMEN AND TECHNOLOGY

Women's biological and social roles are inseparably combined to create four distinctive functions for them. That of wife, mother, home maker and worker. Home as work site is a very important area of women's work in villages. Demands on women's time at home are many and the worker role is an equally important one. The implements and methods used by rural women do not seem to have undergone changes for ages despite the fact that technologies are available for doing the very task in more productive and in less arduous and time consuming way. Inefficient out dated and back breaking technologies is continued to be used.

SCIENCE AND TECHNOLOGY

Science and technology per say may seem to be gender neutral. But knowledge base is definitely gender bias. Empowerment should be proactive. We have witnessed many instances wherein technology when introduced in certain social milieu leads to displacement of women from their traditional occupations or strengthen their sex stereotype role as women.

Food processing industry at present is going through a great expanse, change and certain segments of work therein can still be a big avenue for women's employment. After independence women professional have emerged, though a very small segment have gained entry in the fields of electronics, information technology, biotechnology, food technology and have been crucial to the development of food processing industry.

Central Food Technological Research Institute (CFTRI), Mysore is a post harvest food technology centre set up in 1950 is a constituent of laboratory of CSIR New Delhi. The Institute is multidisciplinary with R&D in all commodities - food grains, fruits vegetables and plantation crops, meat fish and poultry and R&D in food microbiology, biotechnology, baking technology, process development, sensory and food safety and quality control, Convenience food, oil seeds, packaging, infestation control, food chemistry, biochemistry and nutrition. The total number of food technologies offered to industry is around 350.

The focus of CFTRI technologies have been the development of low cost effective technology

utilization of indigenous raw material, bio friendly technology and high level pursuit for total technology upholding food safety, health and nutrition to all. The societal mission of the institute include periodically arranging exhibition of appropriate technologies, imparting technical awareness programmes for NGO and state government groups and entrepreneurship development programmes. It also takes up consultancy, sponsored and rural development projects.

The novel processes which can be identified for emerging women entrepreneurs may be classified under the following areas;

- 1 Nutritious foods and food supplementary: Bal Ahar, Composite protein foods, edible groundnut flours, multipurpose food, edible soy flour.
- 2 Convenience foods: Based on traditional foods such as ready mixes, snacks, sweets, idly, vada, dosa, chakli, jamoon, jalebi.
- 3 Other snacks : Fruit bars, jams and jellies, fruit preserves and candies, fruits juice concentrate/ paste/ powder.
- 4 Tomato products.
- 5 Animal products - animal food, chicken dressing, egg coating.
- 6 Infant foods : Weaning foods.
- 7 Food machinery : Papad press (hand/pedal) mini dhal milk; leaf cups/pastes, pest proofing machine,
- 8 Machinery + mills: mini rice mill, mini dhal mill, etc.
- 9 Emerging technologies : Tissue culture, biopesticide, probiotics, biopreservatives, degradable plastics.

Women entrepreneurship development require the multidimensional approach with appropriate technologies/projects (in food processing) credit, implements and designs in puts, marketing channels and the proactive empowerment strategies that encompass the NGO's and Government institutions to implement new ventures.

In order to network and develop linkage literature an appropriate technologies for women entrepreneurs (WE) must be in local language. Differential fee structure for appropriate technologies need to be offered for WE. Proactive approach to provide opportunities for the exchange of ideas technology packages is of immense help.

Sustained efforts to create a science and technology base in rural areas, with technically feasible and economically viable technology packages and maximum value addition and employment/ income generation potential needs to be constantly developed. R&D should not be divorced from production. Integrated scientific and professional approach is required for this multidimensional programme.

WOMEN SCIENTISTS AND TECHNOLOGISTS - ROLE IN NEEM INDUSTRY

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INTRODUCTION

In India around 70% of the population earn their livelihood from agriculture. Rural Indian women are extensively involved in agricultural activities. However, the nature and extent of their involvement differs with the variations in agro-production systems. The role of women ranges from managers to landless labourers and they provide pivotal labour from planting to harvesting and post-harvest operations. In certain areas in India women play a key role as seed selectors and in seedling production. Their knowledge on seeds and seed storage contribute to the viability of the agricultural diversity and production. As weeders, women contribute to crop management. Women prepare and apply green and farmyard manure. As integrated pest management practices are introduced, it could be expected that women's work will increase due to more labour-intensive activities.

With the growing concern over indiscriminate use of chemical pesticides all over the world, the need of eco-friendly technologies for food production has become imperative. Environmentally benign farming practices and knowledge-intensive integrative farming system would be the best option to meet these challenges. Women Scientists and Technologists, as responsible citizens of India, should commit themselves to develop products that are biodegradable and environmentally friendly and advocate the usage of such products. In this context, research on the various parts of the neem tree and the technologies developed for extractions play an important role since neem products could serve as excellent biological pesticides.

THE USES NEEM TREE

The neem tree (*Azadirachta indica* A.Juss) has attained worldwide prominence in recent years. The medicinal uses of various parts of the neem tree (*Azadirachta indica* A.Juss) have been known in the Indian System of Medicine (Ayurveda) for over 2000 years. Aqueous extracts of powdered neem kernels have been used by Indian farmers for control of insect pests for centuries although this practice was given up with the advent of powerful synthetic pesticides. It was only in the 1960s that the harmful effects of these toxic substances on the ecosystem was realized and the quest for more benign pest control agents began. Plants and insects have co-existed for hundreds of millions of years and plants have evolved strategies of keeping insects at bay, by producing secondary metabolites, which are insect-repellent or insecticidal. It was hoped that non-toxic compounds could be isolated from plants suited for insect-control.

Over 2400 plants are known to elaborate insecticidal and insect repellent constituents. But only neem holds out the promise of providing a highly effective, non-toxic and environmentally harmless means of controlling or eliminating insect pests which inflict losses in agricultural production.

Various parts of the neem tree have been in use in India for several millennia for medicinal purposes and Ayurveda regards the tree as a "sarva rogha nivarini". The decoction of the bark is prescribed for fever, rheumatism, lumbago, etc., The oil is used in treatment of tetanus, urticaria, eczema, scrofula, erysipelas and in the early stages of leprosy. Neem leaf juice is used for expelling worms and curing jaundice and skin diseases. Neem twigs are employed in many village communities as a disposable tooth brush and help preserve healthy teeth. Neem leaves kept between folds of woolen or silk clothing is claimed to preserve them from insects. Neem oil, neem cake and neem bitter principles are the major substances from neem seeds that cater to soap, medicinal and agricultural industries. The basic raw material is mainly the neem seeds, though neem bark, leaves and twigs are also needed to a limited extent.

NEEM SEED COLLECTION

According to a survey conducted in 1959, there were about 14 million neem trees in India, more than half of this in UP and the rest in Tamil Nadu, Karnataka, Andhra Pradesh, Maharashtra and Gujarat. A fully grown tree (about 10 years old) can yield about 50 Kg of seeds and half a million tons of seeds should be available annually. Fully mature fruits drop from the trees. Birds relish the sweet mucilaginous portion of the fruits and reject the bitter skin and the seed. Most of the neem trees in India have come up by seed dispersed by birds. The collection of seeds extends from July to September and affords some income to the rural poor. Scientists could advocate the uses of neem and arrange to start a collection center in all the rural areas and coax the women in those areas to collect all the seeds and deposit in the centers. At present, 70% of the neem seeds produced by the trees go uncollected. The women scientists responsible for the center should analyse the seeds for the active content principle namely, azadirachtin, a terpenoidal chemical which is used as a standard to assess the quality of the kernels. Depending on the quality of the kernels, the rural women could be paid for their collection work.

It is unfortunate that no attempt has been made in India to raise large plantation, even though the tree can flourish in arid and in semiarid regions, in poor soils, is quick growing and can withstand drought and high temperatures. However, the neem tree is being used as an avenue tree in many housing colonies of industrial units. Women could be encouraged to raise the neem plants from either the best quality seeds or by distributing saplings from tissue culture.

NEEM OIL AND NEEM CAKE

During the past four decades the Khadi and Village Industries Commission has been responsible for promoting the use of the non-edible neem oil in soap-making. The oil instead being of limited use in medicine has become an important industrial product and neem seeds are being processed in a large number of oil extraction units, especially in the Southern States. Neem cake obtained after removing the oil is in great demand as a fertilizer, since it kills root nematodes and helps lessen insect attack.

CHEMISTRY OF NEEM

Though Indian scientists began research on the neem in the 1920s, it was Butterworth and Morgan

who isolated the chemical, azadirachtin, the active principle in neem kernels during the year 1968. Extensive data on azadirachtin for its tremendous activity against a variety of insects (over 200 species) at a very low concentration (1 - 10 ppm) is available in Scientific literature. This compound prevents the insect larvae from developing into mature insects, which could further multiply and produce new generations. Diminishing the fecundity of harmful insects is an excellent way of improving crop yields. Other parts of the neem tree such as tender and mature leaves, flowers, fruits, fresh twigs, stem bark and root barks have also investigated for their chemicals.

Neem kernels contain 30-40% oil and 2.5 to 3% triterpenoids. The yield of azadirachtin varies greatly with the soil, the climate, maturity of the seeds and length of storage. Lack of uniformity of azadirachtin content is the most striking feature of neem kernels procured from various centers and even from the same center at different periods, which, of course, is of no consequence for the production of the oil and the cake, which are in great demand.

EXTRACTION OF NEEM KERNELS

One of the most promising benefits of the neem tree may be the use of neem extractions as an organic pesticide. According to the World Health Organization, over 20,000 deaths and a million illnesses each year result from misuse or overuse of pesticides in the Third World alone. Neem insecticides have many advantages over traditional chemical methods: research indicates they are not harmful to humans or animals, insects don't become resistant to them, neem extracts do not accumulate in the environment, and they also spare beneficial insects like butterflies and lady bugs.

Scientists have developed more advanced processes and means to convert neem extracts to forms of granules, dust, wettable powders, or emulsifiable concentrates. ***All these extraction procedures and the method of applications with proper dosage should be introduced effectively to the farmers by the Scientists working in this area.***

NEED OF RESEARCH IN NEEM

The development of procedures for effective extraction of the active principles from neem and the standardization of the material obtained with known amount of the active needs still some fine tuning which could be taken up by Neem Scientists and Technologists. Also, neem products degrade and lose their pest-control properties when exposed to sunlight. This is mainly due to the decomposition of the most potent compound in neem, namely, azadirachtin under the influence of sunlight. Scientists are working towards achieving stable formulation from neem. Interesting results have been obtained from the R & D work of our laboratories towards the development of totally natural neem formulation with stable azadirachtin content.

As far as the medicinal properties of neem products, it is not known which component or components are responsible for the various biological activities. Much more work will have to be done tracking down the active principles, whether for use in circulatory disorders, diabetes,

inflammation, cure of ulcer, etc., before any of them can be developed for use in modern medicine. Some progress has been achieved in the use of neem oil as a spermicidal or anti-implantation agent and this will probably be developed for use in population control programmes soon. Hence, there is a lot of scope for Technologists and Scientists involved in the development of alternative medicines.

MAJOR ROLE OF WOMEN SCIENTISTS AND TECHNOLOGISTS

The main aim of the Scientists involved in neem industry for the introduction of neem products as a biopesticide should be to deliver products which are highly cost effective, environment friendly, easy to use, effective against a series of target pathogens and has no adverse effect at higher dosages. **It is in the hands of Scientists to convince the farmers who are the end users to use neem by educating them on the importance of bio pesticides since farmers who are used to seeing the instant killing of the insects by synthetic pesticides will have some apprehension in using neem since neem insecticides kill insects by delayed action.**

CONCLUSION

Perhaps, one of the greatest advantages of the neem is the fact that its fruits may be harvested without destroying the tree, making the neem more profitable standing than felled. We in India are favourably placed in regard to the availability of neem kernel for the manufacture of an effective and non-toxic product for use in agriculture and medicine. **Everything should be done by our Scientists to exploit this opportunity of providing a safe and effective product for use in agriculture from neem which should be considered a precious national resource.**