Phenomics Way to SMART Foods: The New Medicine on the Block-An Indo-German Perspective

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Indian Biotech Industry – A Snapshot

- Indian Biotech Industry is **$4 Billion** in **FY2010-11**, growing at **21.5%**
- **BioPharma** is the biggest (61.7%) growing@ **20.7%** over last yr.
- **BioServices** is next **18.8%**, growing @ **23%** over last yr.
- **BioAgri** is **14.37%** and growing at **28%** (highest) over last yr.
- **BioIndustrial** is **3.6%** growing @**19%** over last yr.
- **BioInformatics** is **1.4%** & growing @ 9%.
- Of 175 Biotech Companies the Top 20 contribute 54% of the Total Revenue
- **BioSupplies** Segment not included
- 5 Top -20 List includes 5 BioAgri Companies with one having 197% growth (Ankur Seeds).
- Bio Agri only limited to GM Crops seeds and Mol.Markers & Trait market.

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Food Vs Drugs

Leave your drugs to the chemist's pots if you can heal your patient with food.

-Hippocrates (460-360B.C.)

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News Article in Science

Science 24 July 2009:
Vol. 325. no. 5939, pp. 380 - 381
DOI: 10.1126/science.325_380

- **NEWS OF THE WEEK**
- **IMAGING:**
- **With 'Phenomics,' Plant Scientists Hope to Shift Breeding Into Overdrive**
- **Elizabeth Finkel***

- Borrowing imaging techniques from **medicine**, **phenomics** offers plant scientists new windows into the inner workings of living plants: infrared cameras to scan temperature profiles, spectroscopes to measure photosynthetic rates, lidar to gauge growth rates, and MRI to reveal root physiology. **Institutes worldwide are racing to build facilities with instrument arrays that can scan thousands of plants a day in an approach to science akin to high-throughput DNA sequencing. The Australian Plant Phenomics Facility, a new $40 million venture** that is the first national lab of its kind in the world, opened its High Resolution Plant Phenomics Centre in Canberra last week. And **other countries are ramping up fast.**

Phenomics : What & Why

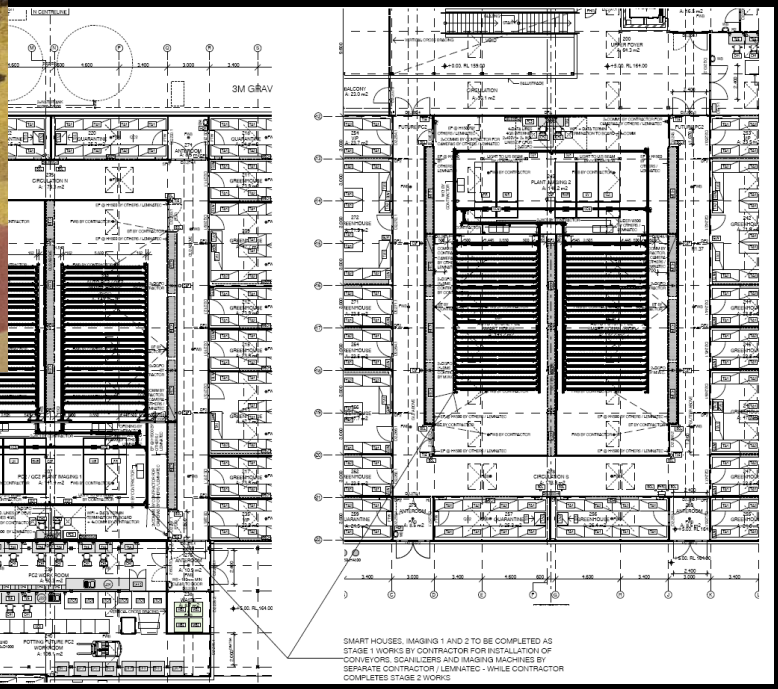
- **Phenomics** – the systematic study of phenotypes on a genome-wide scale.

- **Genomics**
- High throughput analysis of genes and their immediate products, to study the structure and function of genes and genomes
- **Phenomics**
- High throughput analysis of (plant) growth and physiology of an organism, to reveal the role of each gene in the function of the whole (plant) organism.
- **Genomics + Phenomics = Functional Genomics**
- Combining genomics and phenomics will

- - significantly increase understanding of organism (plant) function
- - permit research on previously intractable problems viz Abiotic & Biotic Stress Tolerance
- - speed crop (organism) improvement

-Prof Mark Tester, ACPFG, Adelaide

From Vision to reality – Plant accelerator



Two leading scientist,

the minister of science,

vice head of the university

LemnaTec GmbH

- Founder & Employee owned Company
- Based at Aachen (between Brussels & Cologne)
- Interdisciplinary team of 25 employees in Germany
- Worldwide networked by experienced specialists
- 12 years of experience with image based biological measurement in ecotox, phenotyping, screening
- in-house development of software and hardware
- development of comprehensive biological solutions as phenotyping system provider

Trishna Biotech Pvt Ltd

- A Founder & Employee owned Startup Company
- Based at Gurgaon, (NCR, Nr Delhi, INDIA)
- Less than 2 Years old , registered in Dec2009.
- 6 Employees with diverse background & experience, from Omics Sciences, to Sensors, Electrical, Mechatronix, to Plant Sciences.
- In house panel of experts for technical Consultancy & Project Management.
- Provide Concept Note to Turnkey Projects in Omics Sciences in Agriculture & Medical Biology
- Distribution & Marketing Agreements to IPR genration Agreements with Majors in these fields.

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What We Do

- Develop Phenomics Approaches to SMART Foods by Mining the Phenotypic Variability in the Plant populations and then drill for the reponsible genes, for selection and Breeding.
- Increase Speed of Molecular Plant Breeding through early entry to Market, cut down time to 1/3rd (Euro 5Mio saving)
- Help develop Climate & Disease Resilient Agriculture & Food Production.
- Enable Increase Productivity & Develop Sustainable Agriculture through minimal Fertilizer& Nutrient use.
- Help develop Varieties that are BioFortified or retain traditional tastes and nutritional Quality in Foods.

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SMART Foods

- That can meet the changing demands in terms of nutritional quality and quantity.
- That are able to adapt to changing climate.
- That not only nourish but also prevent us from pathological & physiological diseases.
- That meet our specific dietary and nutritional requirement based on our predisposition to certain diseases.

Examples of SMART Food

- Golden Rice- Iron biofortified
- Gluten free Wheat- For Gluten Intolerance
- Low Sugar Potatoes- For Diabetics
- Soy Milk – For Lactose Intolerance
- Yakult-(Lactobacillus A) – Probiotics
- Neutraceuticals & Food Supplements.
- Drought , Heat, Cold, Frost, Salinity & Submergence tolerant Crops, Vegetables & Fruits, Fishes & Livestock.
- Insect & Disease tolerant Crops & Vegetables (Bt Brinjal)
- Nutritional Supplements: Spirulina, Revital, etc

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Diet & Nutrition related Genetic Disorders & Physiological conditions

- Low Fruit & Vegetable consumption & High well cooked Meat consumption correlated with Breast & Colon Cancers in women.
- Steroids like Estrogens & Goitrogens in Leafy Vegetables cause Hormonal imbalances.
- High Statin levels in Black Currents and some other fruits , cause problems in Hypercholestrolemia patients on Statins.
- CVD, Cancer, Osteoporosis, Osteoarthritis, Obesity, Anorexia Nervosa, Type 2 Diabetes, PhenylKetonuria, ADD/ADHD,

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Genetic Engineering & Phenomics for MicroNutrient BioFortification

- 1st Generation GM crops provide growers with biotic stress tolerance. Selected genes from plant or non plant sources are transferred into desired plants/crops thereby altering the protein expression and the the physiological trait or the phenotype.
- 2nd Generation of modifications would be aimed at identification of plant genes of nutritional importance and then transferring them to desired crops.
- Already Golden Rice is one such example , with high carotene levels it will help prevent blindness in children.
- Many such strategies of Micronutrient biofortification in staple crops like rice, wheat, maize, cassava, beans are underway , to prevent malnourishment of minerals and Vitamins in the developing world .
- These require both allele mining and Marker Assisted Selection of Traits, where High Thoughput and High Precision Phenotyping as in Lemnatec's Phenomics approaches could benefit the Molecular Crop Breeders in reducing the time from concept to market by approx 40-65%, and thereby saving in terms of millions of Dollars.

Nutrigenomics

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By 2020: Nutrigenomics will be a key part of non-invasive health prevention and treatments; individual diets to fit genetic profiles will be mainstream

• We all want to live longer and healthier. Nutrigenomics is the study of how foods affect our genes and how individual genetic differences dictate the way we respond to nutrients in foods.

• It is based on the premise that improper diets are risk factors for diseases and that knowing a person's genetic make-up allows a nutrition regime to be developed that will protect against conditions to which we may be vulnerable. It is set to lead to "Individualised nutrition" - diets based upon genotype, nutritional requirements and status.

• Dr. Kaput said, "we foresee that the application of nutrigenomics to the consumer food market will be occurring over the next five to ten years. The applications may appear to segment the consumer market, but the products that will be developed will be of high value; they will be capable of delivering the right nutrients to the right person at each stage of the life cycle."

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Nutrigenomics (contd)

The role of dieticians will be much more important as science based diet advice becomes mainstream, while nutrition will become integral to GP practices and pharmacies.

• Food will be considered a delivery platform for pharma led initiatives. Food companies will use pharma channels to market their products to healthcare professionals.

• The potential increased cost of such products will likely be offset by reduced costs for health care for the individual and for society. Nutritional screening will become part of health check-ups and consumers will readily provide genetic profiles. Greater differentiation of health insurance as risk profiling becomes more predictive and accurate.

• Business models will be changed as healthy people ultimately pay less; pressure to change unhealthy lifestyles will be much greater. The concept of health as a ‘currency’ will be developed.. New financial investment products related to longevity and health risks will be commonplace

Phenomics- The New Way to Agri-Food Revolution

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- Develop Phenotypic Markers for early detection & screening of traits, and then correlating with the corresponding Genes or QTLs(for Multigenic traits like Abiotic Stress Tolerance)
- Molecular Markers and MAS (Marker Assisted Selection) in Breeding Crops for Multiple Stress Tolerance & High Nutritive & Medicinal Value.
- Develop Tailor made solutions for Phenomics based Interventions in Agri-Productivity & Effeciency

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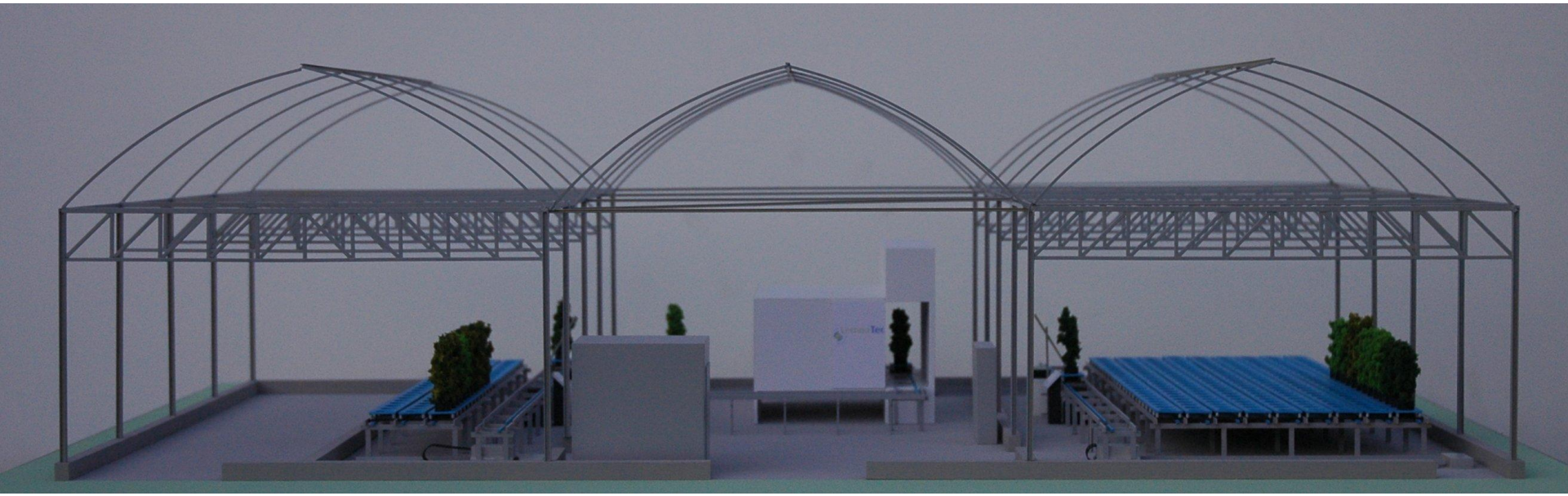
Challenges in Increasing Food Production

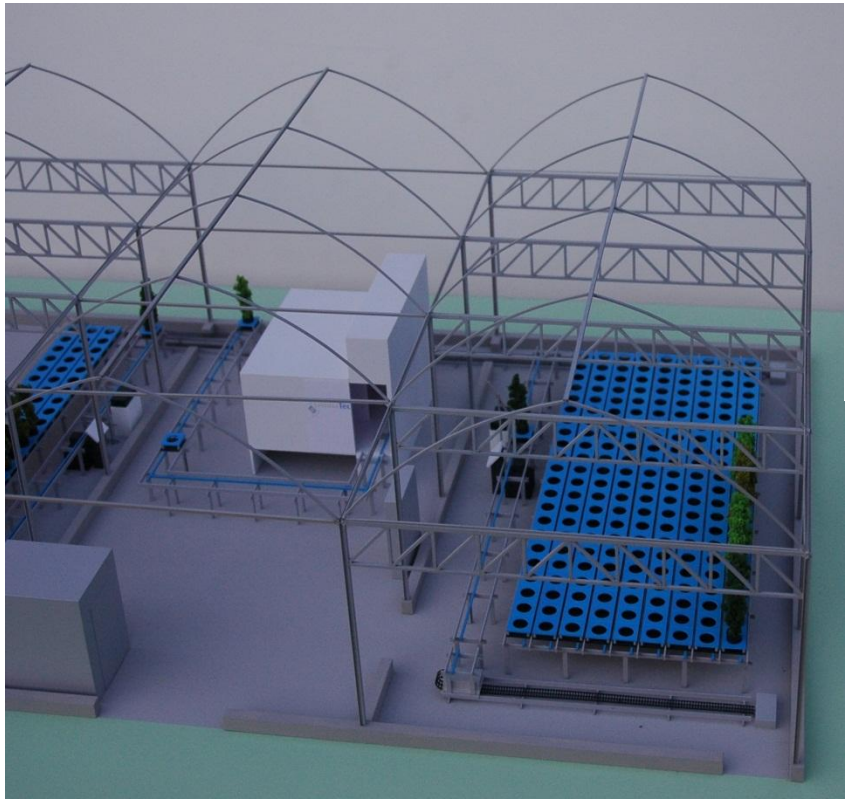
- Reducing Agricultural Land Mass to:
  - Desertification/ Non Arable
  - Rapid Urbanization in India
  - Loss to Biofuels
- Climate Change
- Scarce Human Resources-losing to Cities & Industries
- Scarce Natural Resources, & Increasing Costs of Agro Inputs viz. Water, Ferilizers, Agrochemicals, Environmental Costs

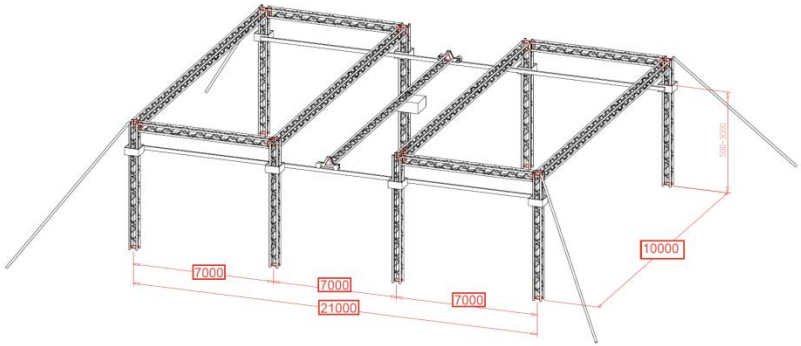
NICRA: Trishna & LemnaTec partnering Climate Proof Food Security

- 4 Phenomics Centres in India for Climate Resilient Agriculture covering Cereals, Pulses, Vegetables & Fruits



Innovation Partners: LemnaTec & Trishna Biotech





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THANK YOU