

Brief-Bio-data

Dr. S. N. Jha is Globally ranked amongst the top 2 % scientists across all fields of research based on citations matrices published in PLOS Biology 2019-20 by Sanford University USA



- 1. Name:** : DR. SHYAM NARAYAN JHA
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- 2. Current Position and Address** : Deputy Director General (Agricultural Engineering),
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3. Educational Qualification

| Sl. No. | Degree/ Certificate | Year of Passing | University/ Institute | Subjects |
|---------|---------------------|-----------------|-------------------------|--|
| 1. | B. Tech. | 1987 | RAU, Pusa, Bihar | Agricultural Engineering |
| 2. | M.Tech. | 1990 | IIT Kharagpur | Postharvest Engineering & Technology |
| 3. | Ph.D. | 1995 | IIT Kharagpur | Agricultural & Food Engineering |
| 4. | JSPS Postdoctoral | 2000-02 | Kochi University, Japan | Post-harvest Technology/ Nondestructive evaluation of Food Quality |

4. Academic/Research/Experience/Employment

| Sl. No. | From | To | Organizations | Scale of Pay, Rs. | Position held |
|---------|------------|------------|--------------------------------|-------------------------------------|------------------------------------|
| i. | 04/01/2022 | Till date | ICAR, HQ, New Delhi | 210000/- fixed+ Personal pay 1800/- | Dy. DG (Agricultural Engineering) |
| i. | 30/12/2015 | 03/01/2022 | ICAR, HQ, New Delhi | 37400 -67000/- RGP 10000/- | ADG (Process Engineering) |
| ii. | 06/05/2015 | 29/12/2015 | ICAR-CIPHET Ludhiana | 37400-67000/- RGP Rs.10000/- | Project Coordinator, AICRP on PHET |
| iii. | 16/05/2013 | 13/02/2014 | ICAR-CIPHET Ludhiana | 37400 – 67000/- RGP 10000/- | Director (Acting) |
| iv. | 17/02/2010 | 16/02/2015 | ICAR-CIPHET Ludhiana | 37400-67000/- RGP Rs. 10000/- | Head, AS&EC Division |
| v. | 26/11/2007 | Till date | ICAR-CIPHET Ludhiana | 37400 – 67000/- RGP 10000/- | Principal Scientist |
| vi. | 26/11/1999 | 25/11/2007 | ICAR-CIPHET Ludhiana | 12000 – 18300/- (unrevised) | Sr. Scientist |
| vii. | 28/07/1998 | 25/11/1999 | ICAR-NDRI Karnal | 10000 – 15000/- (unrevised) | Scientist (SS) |
| viii. | 30/10/1994 | 27/07/1998 | ICAR-NDRI Karnal | 8000-13500/- (unrevised) | Scientist |
| ix. | 10/11/1993 | 29/10/1994 | ICAR-NAARM Hyd and CIAE Bhopal | 8000– 3500/- (unrevised) | Scientist (Trainee) |
| x. | 30/07/1991 | 09/11/1993 | RAU Pusa Bihar | 2200-4000/- (unrevised) | SMS/ Jr. Scientist |
| xi. | 30/12/1989 | 31/05/1990 | IIT Kharagpur | 700-1600/- (unrevised) | Jr. Research Officer |

5. Area of Specialization: Post-harvest/Food/Agricultural Engineering/Food quality evaluation

6. (a) Training/EDP/MDP attended

| Title of the Training | Name of Institution | Duration of Training |
|--|--|-----------------------------|
| Developing Effective organizational leadership | ASCI Hyderabad | 02 – 04 August 2019 |
| | Netherlands, Germany, Belgium, Switzerland | 21 – 30 Sept 2019 |
| Workshop training on Priority setting, monitoring and evaluation | NIRD Hyderabad | 16-20 June 2008 |
| MDP on public private partnership for innovation in Agriculture | IIM Lucknow | 20-24 July 2009 |
| MDP on Leadership development | NAARM Hyderabad | 26 August–6 Sept 2013 |
| EDP on Leadership development | NAARM Hyderabad | 27-31 August 2016 |

(b) Teaching/HRD/Capacity building programme involved as Teacher/course Director

| Name of the program organized | Organizations | Year | Duration |
|---|---|-------------|-----------------|
| Taught many UG, PG and PhD courses | NDRI Karnal | 1994-99 | 5 years |
| Programme Incharge of IGNOU one year Diploma course | IGNOU New Delhi | 2006-07 | 2 sessions |
| Summer School on Design of storage structures and quality assessment techniques for agricultural produce | ICAR sponsored Co-course director | 2003 | 21 days |
| Winter School on Nondestructive and biosensing methods for food safety and quality assurance | ICAR Sponsored Course Director | 2007 | 21 days |
| National Training on “Rapid and nondestructive evaluation of food quality and safety factors using spectroscopy and biosensing methods” | ICAR-NAIP sponsored Course Director | 2011 | 14 days |

(c) International Exposure

| Programme participated in | Name of Institution | Duration of Training |
|--|---|-----------------------------|
| Training on Developing Effective organizational leadership | Netherlands, Germany, Belgium, Switzerland | 21 – 30 Sept 2019 |
| Visiting scientists/training on non-destructive evaluation of fruit quality using spectroscopy | University of Wisconsin, Madison, USA | 13 Sept 2009 to 12 Jan 2010 |
| JSPS Post-doctoral fellowship | Kochi University Japan | March 2000 – March 2002 |

Major International Linkages developed

- (i) Purdue University, **USA** for imparting trainings on biosensor to Indian scientists at ICAR-CIPHET Ludhiana
- (ii) University of Wisconsin, **USA** for research on non-destructive evaluation of food quality
- (iii) Kochi University Japan and JSPS Japan
- (iv) American Society of Agricultural and Biological Engineering, **USA**
- (v) NAM & Other developing countries and S & T for post-doctoral research at CIPHET Ludhiana

7. Membership of Authorities/Bodies of Universities

Involved/worked in numerous committees, policy/regulations making bodies/societies/organizations. A few of them are enumerated hereunder:

- i. Chairman Scientific committee of Food Safety and Standard Authority of India
- ii. Chairman Food and Agricultural Division (FAD)-20 (for Food processing equipment and machinery design) of Bureau of Indian Standard (BIS), New Delhi

- iii. Advisor to Agricultural Scientists Recruitment Board, DARE, BIS, CSIR, MoFPI, Govt. of India
- iv. Vice-president (as India representative) (CSAM), UNO
- v. Member of Governing Council of Centre for Sustainable Mechanization (CSAM), UNO for three years
- vi. Member of Governing body of NIFTEM Kundli, Sonipat, Haryan
- vii. Member Agricultural & Processed Food Products Export Development Authority (APEDA), Govt. of India
- viii. Member of Codex Alimentarius Committee of Food Safety and Standard Authority of India (FSSAI)
- ix. Member of Scientific panel of FSSAI
- x. Member, Executive Council of Dr. BSKKV, Dapoli, Maharashtra
- xi. Member Board of Management, MPUAT, Udaipur
- xii. Member Board of Governor, National Institute of Food Technology and Entrepreneurship Management, Sonipat Haryana
- xiii. Member Research Project Evaluation and monitoring Committee, Office of Principal Scientific Advisor, Govt. of India
- xiv. Chairman Food and Agriculture Division (FAD) – 16 of BIS, Govt. of India
- xv. Member Project Evaluation and monitoring Committee, Science & Engineering Research Board (SERB), DST, Govt. of India
- xvi. Member Inter-Ministerial Committee of MoFPI for Determination of Processing Level of India
- xvii. Member of Expert panel in VAIBHAV Summit 2nd -31st October 20120 organized by NITI Aayog
- xxiii. Expert Panel member of Odisha Bigyan Academy, Odisha Government
- xix. Member Inter-Ministerial Committee for Post-Harvest Losses estimation in the Country by MoFPI
- xx. Member CSIR Project Evaluation and monitoring committee
- xxi. Member, National Committee on Plastic Applications in Horticulture
- xxii. Member of Executive Council of National Academy of Agricultural sciences (NAAS)
- xxiii. Member of Sectional Committee of NAAS, India
- xxiv. Member of Journal scoring committee of NAAS India
- xxv. Member – Secretary of CIPHET Research Advisory Committee and member of Institute management committee of three other ICAR institutes
- xxvi. Member of ICAR Indian Grain Storage Working group

8. External Funding Attracted

Several externally funded research and infrastructural development projects altogether of **more than Rs. 2222 Lakh** on personal capacities and about Rs. 20 crores as Deputy DG ICAR were brought for institutes under me. Worldwide contacts, ability to make proposal, personal impressions and achievements as a team helps attracting any required amount of funds for the organizations wherever he works

9. Honors/Awards/Recognition

(A) Fellowships/Recognition/Awards

I. Fellowships of

- i) Founding fellow of Bihar Agricultural Science Academy**
- ii) National Academy of Agricultural Sciences (NAAS) India**
- iii) National Academy of Dairy Science India
- iv) Indian Society of Agricultural Engineers (ISAE)
- v) Institution of Engineers India
- vi) Japan Society for Promotion of Science (JSPS) Japan**

II. Awards/recognitions

- i) **Founding President** of Bihar Agricultural Science Academy (2023-2026)
- ii) **President** of Indian Society of Agricultural Engineers (2021-2024)
- iii) Best poster-paper award in 28th ICFOsT held virtually by AFSTI during January 20-22 2022.
- iv) **Globally ranked amongst the top 2 % scientists across all fields of research** based on citations matrices prepared by Sanford University USA and published in PLOS Biology (August 12 2019)
- v) Distinguished Alumni Award 2020 of CAE Dr.RPCAUPusa Bihar
- vi) Best Research Paper Award 2019 of Journal of Agricultural Engineering
- vii) **Gold medal 2018** of Indian Society of Agricultural Engineers for Outstanding contributions to science and Society (Life time achievements award)
- viii) Best Research Paper of 2016 published in Journal of Agricultural Engineering
- ix) **ICAR Chaudhary Devi Lal Outstanding All India Coordinated Research Project (AICRP) Award 2015** as Project Coordinator of AICRP on Post-harvest Engineering & Technology
- x) **Societal Innovation Prize of NRDC, Govt. of India** - 2013
- xi) **ISAE Team Research Award (as Leader of Team)** - 2012
- xii) **Recognition Award 2011-12 of National Academy of Agricultural Sciences**
- xiii) **Best Poster paper** Award 2012 in 46th ISAE Annual convention and International symposium
- xiv) **ICAR Rafi Ahmed Kidwai Award 2011** for outstanding research in Natural Resource Management & Agricultural Engineering. **It is highest individual award of ICAR**
- xv) **ISAE Commendation Medal** - 2007-08 for outstanding contribution in Food Processing
- xvi) **Dr. J.C. Anand Gold Medal-2006** of Horticulture Society of India
- xvii) **First Best Scientist of the CIPHET Award** in 2005
- xviii) **Young Scientist Award** for the year 1997 of AFST (I), CFTRI Mysore
- xix) **Second Best Poster Paper Award** in International Food Conference -1993, CFTRI Mysuru
- xx) **Reddy Award - 1989-90** of ISAE for outstanding postgraduate thesis.
- xxi) **National Merit Scholarship**, till B Tech degree

10. Professional Affiliations

- (i) **Founding fellow of Bihar Agricultural Science Academy**
- (ii) Fellow of National Academy of agricultural Sciences, India
- (iii) Fellow of Institution of Engineers (India)
- (iv) Fellow of Indian Society of Agricultural Engineers
- (v) Fellow of National Academy of Dairy Sciences India
- (vi) Life member of Dairy Technologies Society of India
- (vii) Life member of Indian Dairy Engineers Association
- (viii) Life Member of Association of Food Scientists and Technologists (India)
- (ix) Editor (Processing, Dairy and Food Engineering) (2012-22) of **ISAE Journal of Agricultural Engineering**
- (x) Associate Editor (since 2017) of Journal of Institution of Engineers (Series A), Springer

11. Major Contributions as Scientist & R & D Manager/Leader

- (a) **Research Publications including popular articles/books/book chapters/ conference proceedings/presentations/training manuals etc: >297**. List of publications and patents can be seen at www.snjha.in. **h-index 38 & total citations >4693** as on 03/08/2023

- (b) **List of best professional outputs/outcomes** in last 10 years, relevant to present field of specialization
- (i) Formulation of colour based maturity index and eating quality of mango and method to predict them nondestructively (**BIS standard IS 9304 revised in 2012, patent grant no: 250880, Licensed to M/S Neotel Systems and Services Pvt Ltd, Chandigarh**). Considered pioneer for research on nondestructive methods for food quality evaluation (**ICAR Citation: Rafi Ahmed Kidwai Award 2011**) and taking initiatives for establishment of **food testing labs** in India.
 - (ii) Developed physico-chemical properties based maturity indices for nine mango cultivars and method of predicting them along with eating quality using NIR spectroscopy (**patent no 309470, besides development of FTIR technique to authenticate sweetness of mango juice (Jha and gunasekaran 2010)**), identification and behavioural study of properties and their modeling for computing freshness index (**Jha & Matsuoka 2002**) of eggplant fruits, overall quality index of apple (**Jha et al 2012**), and roasting behaviour of gorgon nut (*Euryale ferox*) (**Jha 2005**). The system is being manufactured by a Bengaluru based company and is under field testing/demonstration. He has also proven the *Maldah* variety of mango of Bihar may be the most suitable for processing, value addition and rural industrialization in the region of Bihar, eastern UP in general and *Mithilanchal* of Bihar state in particular.
 - (iii) Development of CIPHET Evaporative Cooled Storage Structure with maximum possible cooling efficiency (up to 20 °C drop from outside temperature, **licensed to 5 agencies** and given drawing and designs to more than **12 farmers/entrepreneurs**) for storage of fruits and vegetables (**Jha S. N. 2008**). **Recently Govt of Odisha, Chhatisgarh and Bihar have included it in their NHM programme**. In addition, developed **containers for horticulture train in sponsorship of NHB for distant transport of fruits/vegetables. The Govt. of India is now running Kishan Train for transportation of perishables from its production site**.
 - (iv) Development of process technologies & machinery for popping and decortication of *makhana* (**patent application no 434144**.) **licensed to four private manufacturers five times** for manufacturing and marketing.). **This has won NRDC Societal Innovation Award 2013. The machine is fully commercialized**. Due to his untiring efforts in research and policy making, marketing including exports of *makhana* has increased by more than 40 % in last 3-4 years. He is popularly, because of continuous efforts and fruitful results, known as *makhana* man of India.
 - (v) Development of ready to constitute *makhana kheer* mix (**Licensed for commercialization on royalty basis to M/S Vijay Raj and Company, Darbhanga, Bihar, M/s Ultra Bio Naturals, Baddi, Himachal Pradesh and M/s A1 Foods India Pvt Ltd, RR District Telangana and three more companies of different states, Patent grant no 287541**). Pioneering the research in post-harvest processing of *makhana* (**ICAR Citation: Rafi Ahmed Kidwai Award 2011 and Citation of NAAS Recognition Award 2012**).

(c) Highlights of contributions to the area of specialization

Major contributions to the area of specialization are: development and commercialization of process and machinery for popping of *makhana* (*Euryale ferox*) and their value added product ready to constitute *makhana kheer* mix, mechanized system for manufacturing *chhana* ball for continuous manufacture of *rassogolla* being used by AMUL, nondestructive techniques to know ripeness; eating quality of mangoes; freshness index of eggplant and correlation of the same with market price after storage, and overall quality index of apple. Enrichment of literature by giving new mathematical concepts of roasting of grains, modeling of colour values of mango, and extraction of juice from citrus fruits. A community level evaporatively cooled storage structure design is much in demand. Development of a porous brick using biomaterials for construction of storage structures and farmhouses is an important contribution for utilization of farm residues.

More than 278 research papers/book chapters/conference presentations/ patents and five books are highly cited in literature. **Total citations are more than 4693 and h-index 38 on Google Scholar as on 03/08/2023.**

Major areas of professional interests are nondestructive methods of quality evaluation of food, development of new products/process and machinery and design and development of storage structures for fruits and vegetables and guiding/working on new ideas of future needs **in Agriculture in General and Agricultural Engineering in Particular**

Present activities are planning, monitoring, policy support and management of research in the field of Agricultural Engineering including Post-harvest Processing, value addition, energy in agriculture etc. and to give leadership to various research projects and consultancy works in the field of Entrepreneur development, agro-processing/value addition and agricultural mechanization at National Level.

(d) Highlights of major contributions as Institution Leader/R & D manager

As Head of division five new laboratories established, three new fields of research (nondestructive evaluation of food quality, microencapsulation, and smart packaging) started, more than 10 crores research funds attracted and arranged overseas visits of 6 scientists. Division, on an average, produced more than two research papers and one patent per year per scientist, besides commercialization of majority of them. Probably first time a laboratory of division of ICAR institution got **ISO certification. QRT of that period of ICAR-CIPHET Ludhiana judged the best division of the Institute.**

As Project Coordinator of AICRP on PHET started 17 new value chain projects and established more than 50 agro-processing centres through AICRP's centres in different parts of country. Harvest and post-harvest loss assessment of major crops and commodities at national level were determined and the same is being used for policy making by governmental and non-governmental institutions/organizations. Culture of publications, patents and commercialization introduced and result was that this AICRP **won The ICAR Chaudhary Devilal Outstanding AICRP Award for the first time in 2015.**

As Director of ICAR-CIPHET Ludhiana the whole Institute received ISO 9001:2008 certification. Conducted Parliamentary Committee Meeting on Hindi and received the appreciation letter for the way meeting was organized under my leadership. Conducted record 22 DPC for CIPHET staff in 9 months. Organized IMC, RAC, IRC, IJSC (3 no), monthly SOC etc and utilized all the budget provision of the Institute including NAIP in record time by 31st December 2013 itself and achieved 117 % of target of revenue generation of Rs. 40.90 lakh by the institute. Regularized payment of all contractual pending since many years, and made the institute (including Abohar Campus) trouble free, other-wise it was always with labourers problems. Won four court cases in record time in favour of ICAR and Improved work culture, sincerity and punctuality in all staff (at least in 90 % staff).

Efforts were put to increase scientific manpower and got 39 Engineering Scientists' post advertised in ARS 2013 and 8 scientists posted and one got transferred to CIPHET Ludhiana. In addition, about 100 internal/CAG audit para (particularly of NAIP projects) coming since three-four years got dropped by making suitable reply. On Infrastructure development front, International Training Centre, state-of-art BPD Unit, On-line ASRB examination centre, conversion of Abohar campus KVK building to guesthouse, Food Testing Laboratory, Wi-Fi facilities in whole campus (including residential area) got completed and backlog works having time-overrun and cost-overrun since 2006 got regularized by the council. Modernized two laboratories and about 10 new constructions were conceived and got approved in the 12th five year plan. More than 50 % staff got training, PDF scheme with international organization initiated and MoUs were signed at least with three universities during the period. **AICRP on Plasticulture Engineering and Technology received ICAR Chaudhary Devilal Outstanding AICRP Award and institute's RFD reached from near good (when took charges) to the excellent level (when handed over the charges).**

As ADG (process engineering) at ICAR headquarter following are major contributions in policy making/programme implementation at National level.

Prepared and got two Plan SFC Titled “Post-production mechanization and value addition” and “Fibre processing and value addition” for 2017-20 approved. Monitoring and management of ICAR’s engineering institutes and two AICRPs (PHET, PET) and 3 CRPs on Health food, secondary agriculture and natural fibre. Budget of Engineering SMD got increased by about 75 % for these schemes in 2018-19.

I was directly involved in policy change in engineering aspects of ICAR and got merging of two ARS disciplines (APE & ASEM to one AS&PE), approved two new ARS disciplines, i.e. Electronics & Instrumentation Engineering and Textile manufacturing and technology and cadre review of scientific, technical and administrative staff of all ICAR Engineering Institutes approved. Two new divisions’ one on “Automation and sensor technology” and other on “processing and value addition of natural resin and gums” in ICAR-CIPHET and ICAR-IINRG Ranchi respectively were got opened. I was instrumental in delegation of power for purchase of approved laptop/tablets to Director of ICAR Institutes and change of name and mandate of NIRJFT Kolkata to National Institute of Natural Fibre Engineering and Technology (NINFET), Kolkata. Involved directly in Loss assessment in FCI and CWC godowns and framing national policy for the same to store and release of wheat and rice; and framing of storage protocols, milling outturn etc for pulses under ministry of consumers’ affairs under my guidance and supervision. **A uniform norm of FCI for loss assessment fetching it about Rs. 500 crore annual benefit.** Post-harvest/processing aspects and establishment of Post-harvest equipment testing centres are added for funding in RKVY schemes of Govt. of India, Establishment of Food Testing laboratories, Pradhan Mantri Sampada Yojana, Gramin Samridhi Yojana of MoFPI, Govt of India were made using my input and majority of them are in operation at National level. Policy paper on secondary Agriculture – Challenges, opportunities and way forward published by NAAS India under his leadership.

As DDG (Agricultural Engineering) several reforms, in the division/ICAR; their activities & expansion in work and institutions, were undertaken. Few important amongst them are: Upgrading status of ICAR-CIAE Coimbatore extension project to Regional centre, ICAR-CIPHET Ludhiana Abohar campus to full-fledged regional research station, changing name, mandate, objectives of ICAR-IINRG Ranchi, to ICAR-National Institute of Secondary Agriculture, Ranchi, upgradation of *Makhana* Research Centre to National Research Centre (NRC) with expanded mandate of work in the field of all aquatic crops and bringing this NRC to Agricultural Engineering division from Natural Resource management division of ICAR. Dr. Jha has put his entire career for bringing *makhana* in forefront not only in ICAR but at the world level through his research since 1988 to till date and administrative/policy support for research projects and restoring the original status of Research centre of *makhana* at Darbhanga. He was and is at centre stage in establishing Bihar Agricultural Science Academy in March 2023 and is the founding President of the same. He has also brought Indian Society of Agricultural Engineers at forefront and by bringing several changes including constitution, bye-laws and rules as the most vibrant effective scientific society of India as its President. Parliamentary standing committee on Agriculture by his inputs and efforts has recommended to employ Agricultural Engineers in each block/panchayat level and open a Directorate of Agricultural Engineering in each state to boost the farm mechanization in the country and the report was laid down in Lokshabha and Rajyasabha for implementation by the concern departments and state governments. Signing MoU as President Indian Society of Agricultural Engineers with the American Society of Agricultural and Biological Engineers for Engagements for Global activities of Agricultural Engineering and also for students programme, publications etc. Policy paper for secondary Agriculture, Policy recommendations for restricting import of Combine harvesters, rice transplanters, ballers and validity period of test report of agricultural machinery for helping Indian manufacturers towards becoming self-reliant and also making “make in India” policy more successful.

12. **Publications:** Papers in refereed journal: 114, Books: 05, Book Chapters: 22, Popular articles: 27, Reports/bulletins/manuals/policy paper: 15, Paper presented: 95, others: 04 nos

13. **Number of books Authored/edited** :05 (One each from Springer and Elsevier)

14. (a) **Number of patents/copyrights/trademarks/IPR granted/applied for and highlights of translational research contributions**

- (i) **Patent granted** : 06
- (ii) Patent in granting process : 05 (including one PCT countries)
- (iii) NCBI Registrations of microbes/ MTCC depositions of culture : 82 no

(b) **Technologies developed, licensed and/or commercialized**

| | | |
|-------|--|--|
| (i) | Indigenous process for manufacturing of protein isolate from oilseed cake/meals. | It is a microbial unique and almost green method for production of protein isolate/concentrate from oilseed cakes/meals. Indian Patent Application No.13362/DEL/2019. PCT International patent application no: PCT/IN2020/050287 dated 27/03/2020 and is licensed to M/S Samyog Health Food Prvt. Ltd. Mumbai for manufacturing. |
| (ii) | Process for fat free flavoured/spicy/crunchy <i>makhana</i> | No fat for roasting and adding flavor/spice in popped makhana is added. It is crunchy/healthy products and replacement of many junk foods/chips etc. Indian Patent application no. 036120/DEL/2019. The process has been licensed to six private companies for commercialization |
| (iii) | CIPHET Evaporatively Cooled Storage Structure for fruits and Vegetables | It is ideally designed 5 tonne storage structure based on water evaporation. It is most suitable for storage of fruits and vegetables in hot and dry region. Adopted by farmers, government and private agencies. It is also included in NHB pack house project |
| (iv) | Tomato primary processing and puree making plants | Licensed to two entrepreneurs Mr. Ushir Shantosh Murlidhar, Maharstra and Mr. Amaranatha Reddy of Madanapally, AP. Machinery designed are being sold by M/S Osaw Agro Industries, Pvt. Ltd., Ambala without license since 2003 |
| (iv) | Ventilated and insulated freight containers for fruits & vegetables | Designed, tested in collaboration of CONCOR, TRANSAFE and NHB for long distance transport of fresh fruits and vegetables. National Horticulture Board, Gudgawn Govt. of India tested and commercialized the technology. Latter Rail transport system was named as Horticulture Train. Performance of the system was excellent. Now Government of India is running as Kishan train |
| (vi) | Method of determining maturity of mango in tree | It computes maturity of mango based on TSS and colour . Patent grant number 250880 . Technology is licensed to M/S Neotel Systems and Services Pvt Ltd, Chandigarh and formulae has also been adopted in BIS standard IS 9304: 1979 revised in 2013 (Guide for harvest and storage of mango). |
| (vii) | Mechanized system for roasting popping and decortication of <i>makhana</i> seeds (Gorgon nut, <i>Euryale ferox</i>) | This is the first machine for popping and decortication of <i>makhana</i> seeds (capacity 30 kg/h efficiency 95 %) raw seeds. It has been licensed twice to M/S Jwala Engineering and Consultancy Services; Ambala and three other manufacturers. It almost eliminates all the drudgery involved in manual method and also improves the quality of popped <i>makhana</i> . Simply decortication of seeds can also be done which was hitherto not possible. About 10 plants have come up on this in different part of India. It has won NRDC Societal Innovation Award. Patent no 434144 . |

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|--------|---|--|
| (viii) | Method of predicting maturity stage and eating quality of Indian mangoes using near Infrared spectroscopy | A single maturity index of 8 major varieties of mango was developed using various bio-chemical properties; and a NIR prediction model with protocol predicts ripeness level and eating quality nondestructively. It has opened new vistas of research and many projects/works now are being carried out in this field. Patent no 309470. Instrument is manufactured by a Bengaluru based company for marketing |
| (ix) | Ready to Constitute <i>Makhana Kheer</i> mix | <i>Makhana kheer</i> can be prepared instantly and without cooking. It is the First product patent of ICAR. Patent Grant no 287541. Technology has been licensed to six entrepreneurs/private companies. The product is highly acceptable and profitable. |
| (x) | Autoclavable microencapsulation system | It is an autoclavable microencapsulator having multi stage jet break up system using two fluid nozzle for clean production of microcapsules. Licensed to M/S Singh Glass Work, Ludhiana Patent No.324943. |
| (xi) | Method of manufacturing porous bricks | The process uses paddy straw, wheat straw and earth as major ingredient for manufacturing porous brick, which is about having one third less weight than the traditional brick with strength equivalent to Class II brick. It is very good for partitioning wall, having high insulation properties. Good for making Evaporative Cooled Storage Structure. Patent Application no. 1883/DEL/ 2008 and is Licensed to M/S Rajinder Dev & Company, Ludhiana for manufacturing and marketing. |
| (xii) | A mechanized system for continuous production of <i>chhana</i> ball for making <i>rassogolla</i> | The system developed produces about 46 <i>chhana</i> ball of homogeneous and uniform size and weight of 6 g per minute. It helped in mechanization of <i>rassogola</i> and <i>gulabjamun</i> production in the country. Technology is Licensed to AMUL, Anand and is commercialized. |
| (xiii) | Value Chain/ Agro-processing centres | (i) Value Chain on <i>makhana</i> popping is comprising, cleaning, drying, grading, roasting and popping, grading of popped <i>makhana</i> and value added products like, bran, ready to constitute <i>makhana kheer</i> mix were developed; and first part has been established at about 10 places in India. (ii) Value Chain for primary processing and manufacturing of tomato puree and the same is being manufactured and sold by Osaw Agro Industries Pvt Ltd. Ambala. (iii) Twenty Agro-processing centres as project Coordinator and about 31 as ADG (PE) established throughout country in farmers' field and they are running successfully with greater profits. |

15. Dissertations Supervised

- a. Postdoctoral : one (International)
- b. Post-graduation : 4 (co-supervisor)

16. 1 – 2 page summary of vision as Leader in the field

India's agricultural production is at all-time high and is almost in increasing order. It is in the changed world scenario is becoming one of the major food exporter. Post-harvest losses of 45 major crops are of more than Rs. 92 thousand crore. People therefore have started talking, **“whether we produce more for losing more?”** No of farmers are rapidly reducing, youth are almost not interested in traditional type of agriculture, startups are coming at faster rate and introducing modern technologies at faster rate. So We have to also change our focus rapidly. Some of prioritized areas of research in my vision are:

- i) Determine the profitable, processable, and machine harvestable characteristics/attributes of Indian agricultural commodities and get developed such varieties so that mechanization and automation in agriculture becomes easier and our food industries use only Indian produce as raw materials for developing rural agro-industrialization. (**Collaboration amongst different stakeholders**)
- ii) Alternatives of cultivating food grains needs to be searched, because how long our natural resources will be available for production of foods are not fully known. Climate change is other big threat to our production system. **Basic and strategic research therefore needs to be started** to manufacture food grains in factory using modern technologies such as bio-technology, nanotechnology, fermentation technologies, super critical extraction, distillation technologies, extrusion technologies, **3-D food printing** and new tools and machinery. Not only India, but the whole world wants food factory to feed ever increasing population (**Changing strategies in crop variety breeding to basket**).
- iii) India must go for **precision** agriculture, postharvest management and animals and birds rearing system at least by 2035; and that is only possible when all Agri-activities with electronics, robotics and agri engineers of the country is an integrated part of digital India programme. (**Integration and synergy among different departments and stakeholders**).
- iv) We should engage ourselves to develop modern and cheap community storage structures for using at *panchayat* or block levels for food grain and on-farm storage structures for perishables for promoting decentralized storage of food grains and perishables. Development of hybrid cold storage using solar energy may help in reducing post-harvest losses of perishables considerably. (**Community involvement in development**)
- v) Complete biomass (crop residues, fruits and vegetables by-products etc.) needs to be utilized in better manner for production of energy, high value-low volume compounds and establishment of pilot plants for manufacturing them in production catchments. (**Development of Village Economic Zone focusing on secondary Agriculture**)
- vi) The traditional and modern fried foods lead to increased level of blood cholesterol. Food Scientists should start working on development of process protocols and new frying mediums like fat replacer in food products for zero absorption of oil/fat by them (**Health foods production and promotion**)
- vii) India has a treasure of traditional foods which are slowly disappearing. This treasure needs to be preserved. Concerted and accelerated efforts are required to mechanize production and processing of the same for quality production with minimal human intervention (**Steps towards preservation and marketing of our traditional foods**).
- viii) Nowadays lifestyle of people, their working environments and climate are cause of various diseases such as headache, cancer, irregular blood pressure etc. We should devote to develop pharmaceutical active ingredients, nutraceuticals and disease curing products. (**reduction in import and making India self-reliant in these products**)
- ix) Food Safety is one of the major concerned for the country. Available test methods are time and resource consuming. Multi-institutional efforts are needed to create facilities for working on sensor and sensor based technology for in-situ quality check of food, application of artificial intelligence in decision making; internet of things for stored food products for saving them from spoilage (**Focus on reducing food borne diseases**)
- x) Substantial increase in number of research publications and their quality, accelerated technology licensing and commercialization, and if possible, establishment of its own products manufacturing and marketing wings for making the institutions financially self-sufficient (**making India hub of Agri-start-ups**).

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