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# AGRI-Life

"Entrepreneurship Development and Self Reliant India : Post-harvest Technologies for Utilization of Bundelkhand Specific Bio-resources"

## Transforming agriculture in Bundelkhand through rainbow revolution.....


Rani Lakshmi Bai Central Agricultural University
Jhansi-284 003 (U.P.) India

# AGRI-LIFE

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**Director Education**
E-mail : directoreducation.rlbcau@gmail.com

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## From Vice Chancellor's Desk.....

Inaugurated on August 29, 2020, by Hon'ble Prime Minister Shri Narendra Modi Ji, and dedicated to the nation Rani Lakshmi Bai Central Agricultural University, Jhansi is committed to achieving its goal of realising the vision of a prosperous Bundelkhand. It is working for the prosperity of farmers and promotion of Agri-Start Ups and ventures in agriculture and allied sectors for the benefit of consumers and processors. The University has envisioned the setting up of the **'Rani Lakshmi Innovation and Incubation Centre'** for the benefit of University's students, the youth, villagers, and other entrepreneurs. The centre aims to enable the stakeholders to participate in and understand the steps in the setting up of enterprises, become job- providers, and generate employment opportunities mainly in agriculture and other allied sectors like seed production, mushroom production, food processing, agricultural production, agri-inputs (bio-fertilisers, bio-control etc.). Research and development programs focus on developing agricultural and food products under the brand name 'Shri Lakshmi' (SL series). Further, they will contribute to nation-building by connecting with various innovative programs and training in agri- related enterprises acquiring qualifications in agriculture and other fields.

Accordingly, the University had participated in a two-day's Bundelkhand Agri-Processing Summit held on Feb 28-29, 2021, as one of the lead knowledge partners led by District administration and Bundelkhand Chambers of Commerce, Jhansi. The brainstorming workshop on "**Post-Harvest Utilization of Bundelkhand Specific Bio-resources for Entrepreneurship Development"** was also organised by inviting several scientists of repute from ICAR, CSIR and other institutions for the creation of awareness amongst youths empowering them with the latest technologies, products and processes for the value addition of Agri-Horti-forestry crops and produces, besides medicinal and aromatic plants. Agricultural graduates, rural, semi-urban and urban youths were enriched with technical knowledge by the imminent speakers and shared to set up agriculture-based viable enterprises. The basic aim was to sensitise the young minds to become job providers and not just job seekers, which could be possible by academia-industry strong linkages and the role of mentors who can imbibe innovative thoughts and confidence. Government schemes are also available for agricultural entrepreneurship and one can take the advantage of them and the experts in the desired field.

Today's agriculture should not be limited to the farm and develop it according to globalisation and sustainable management methods that need to be made employable and profitable. All the policies have emphasised production, but time has turned on to diversification of use beyond production. We also have to think about export-oriented, quality standard products from domestic market keeping global competition. Today quality is the main parameter in food items, which is also the USP and branding of any product. Bundelkhand has a lot of potential for the renewal of agriculture-based start-ups or cottage industries established in the past. The income and livelihood of poor and tribal people can be strengthened by processing and value addition of a number of products from forest-based produce. In Bundelkhand, more land can be used for agriculture by increasing water conservation and thereby irrigation facilities. Therefore, through this brainstorming workshop, awareness has been created to focus not only on crop production but also on the crop's selection, processing, and market price. There are several new avenues for setting-up industries based on product

diversification in traditional agriculture. Besides, many by-products are being made in pulses and oilseeds, which can further boost the income.

Lastly, I appreciate the efforts made by Dr Anil Kumar and other members of the organising team for the successful organisation and pro-active participation of RLBCAU in Bundelkhand Agri-Processing Summit and also their efforts in bringing out fifth issue of Agri-Life, based on the articles contributed mainly by the imminent speakers of the workshop. I am sure that the current issue will be used widely for the scintillating young minds.

**(Arvind Kumar)**
Vice Chancellor

# *Editorial*

## "Agro-technologies for sustainable development of rainfed and water scarce areas"

Presently, India is the most prosperous country in the world in terms of youth power. This young India should also become self-reliant. For the same purpose, Prime Minister Shri Narendra Modi Ji has announced an ambitious scheme realising the goal of self-reliant India. Among the efforts announced under self-reliant India, many schemes are related to agricultural entrepreneurship, which are basically inspired by the basic mantra of farming as a noble profession compared to any other job. These themes are contemporary in today's perspective also.

The land of Bundelkhand is famous for its social and cultural diversity as well as agricultural diversity. In the past, agriculture-based industries could not be developed locally in the area. Still, this area is progressing in all dimensions, and now there are possibilities of doing all types of farming. Even new horticultural crops like strawberry, dragon fruit, sandalwood, coloured capsicum etc., are being cultivated. Traditional agriculture, which was limited to pulses and oilseeds, is now moving towards commercial farming. Due to the lack of agro-based industries, it was difficult to exploit the agricultural produces and bio-resources of the region. Bundelkhand is very suitable for agrarian diversification, despite the heterogeneous geographical and socio-economic conditions, and the hardworking farmers here can raise new crops successfully. In today's environment, the goal of doubling the income in the agriculture sector is possible through value addition and investment in processing sector.

Along with innovative technology, value addition to agricultural produce and obtaining economic benefits from farm products is the key to success. Therefore, our emphasis should not be limited to primary production but to promoting secondary and tertiary agriculture. The farmer grows a lot, but what, how, and why is still in a narrow range. For example, coarse cereals which were once grown in traditional farming but due to low production and low market price, farmers are not producing it on the earlier scale, but due to its health benefits today it has become an excellent and VIP agricultural commodity and therefore, its products are being sold in various forms. Many medicinal and aromatic plants are also produced here. The leading new and old ayurvedic pharmaceutical companies used to run entirely from the raw material produced in the Bundelkhand. Today, further changes are taking place in the agriculture sector, and processing, packaging, and marketing have become tools that can be used for any development.

Innovative thinking is needed at every level to create a start-up by presenting new dimensions in the agriculture sector. Bundelkhand needs another revolution, which will give this region a new ray of hope by forwarding it towards agricultural entrepreneurship. The specific products produced here are peas, ginger, coarse grains, chironji, sesame, lentils, all of which have a unique taste other than groundnut, mustard and chickpea. Vegetables and fruits can also benefit the farmers by giving reasonable prices after processing. Figs, pomegranates, citrus fruits, wild fruits, beets, tomatoes, and new varieties can be grown in protected cultivars, and thus off-season vegetables can offer reasonable prices. Marketing is no longer a problem in today's era because, in the age of the digital and information revolution, one can buy and sell products from anywhere with higher profit.

During the Corona period, when the country is going through a socio-economic and mental crisis, and keeping in mind the call of Prime Minister Modi for a self-reliant India, the acceptance of medicines and

related crops along with agricultural and nutritious products, which are helpful in the war of malnutrition and health is a positive sign. For this, there is an urgent need for high-quality research and development programs so that consumers can get tasty, healthy and nutritious agricultural and food products at reasonable prices. Such value-added nutraceuticals, pharmaceuticals, cosmeceuticals, functional foods, smart foods and other health products are in great demand among the general public. And in the Corona era, the consumption of such value-added products, collectively called Nutri-Ayur products, is in high order among consumers, so the University is also promoting research and development programs of Nutri-Ayur products in this area. Because of the immense potential in this field, there is an urgent need to encourage research and manufacture of food processing and Nutri-products by the state and central government through the University in Bundelkhand.

The brainstorming workshop held by the partnering of district administration, BCCI and participation of people has stimulated how small, medium and cottage industries can be set up based on agriculture and guided by the experts of many subjects for the benefit of students, farmers and new entrepreneurs and has also geared up to learn about new, healthy and nutritious products that can be made from fruits, flowers, grains, medicines, plants and forest products. Today most of the small- scale industries are based on agriculture, and many new products are being introduced in the market every day. Now even Agri-Start Ups are developing based on input and output. Agriculture has now become a sign of entrepreneurship and many big companies have also entered the market of agricultural products. During the workshop, diversified agricultural enterprises have put up an exhibition to showcase their products and demonstrate agriculture's feasibility and prosperity. Even 10 per cent of the crop yield produced in Bundelkhand is not processed and value-added. Several businesses and jobs can be generated if we develop entrepreneurship in this sector. Self-employment is the primary key of agriculture, which can open immense doors for agriculture/horticulture, dairy, and forestry students.

It is my pleasure to present you the fifth issue of Agri-Life having expert contributions by the learned speakers of the workshop. In the end, readers are requested to read carefully and consider the detailed articles and narrations provided. I solicit valuable feedback from the readers, the students and research communities, who will use such knowledge in venturing the Agri-Food processing- a sun rising sector.

**(Anil Kumar)**
Editor-in-Chief

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# Bioresources to bioeconomy: A paradigm of livelihood generation

**Sanjay Kumar* and R.K. Sud**

Himalayan environment nourishes and nurtures specialized plant resources with medicinal, nutraceutical, and pharmaceutical values. Such unique bioresources open vista of opportunities to generate and promote entrepreneurship to sustain livelihood in the Himalayan states, which are vital since 85 per cent of the land holdings are small and marginal, resources are limited and 66 per cent of the population depends on agriculture based activities.

CSIR-Institute of Himalayan Bioresource Technology, Palampur, Himachal Pradesh has been committed to discover, innovate, develop and disseminate processes, products and technologies from Himalayan bioresources using cutting-edge science and technology. The institute has taken unique initiatives for promotion of specific high value crops for livelihood and product development while harnessing the advantages of Himalayan environment. Given below are some of the technologies based on value added agriculture or green process or biotechnological application which have huge potential to create and support agri-entrepreneurship based on the bioresources:

## I. VALUE ADDED AGRICULTURE

**1. Introduction and Cultivation of High Value Crops**: CSIR-IHBT undertook precise initiatives in introducing high value crops for harnessing advantages of unique Himalayan environment for livelihood enhancement, product development and boosting entrepreneurship.

**1.1. Hing (Asafoetida):** The institute took *hing* cultivation in Himachal Pradesh in 2016 with import of seed through NBPGR to utilized the entire barren area cold regions of Himalayas as done by Iran and Afghanistan in their countries. The institute developed agrotechnologies, quality profiling and DNA barcodes and thereafter in July 2020, the institute in collaboration with the State Govt. initiated its large scale cultivation in 133 locations all across hilly districts of HP and few in Ladakh. The crop has potential to generate an income of Rs 5 lakh/ha against Rs 0.4 lakh from traditional crops and to substitute annual import of 1540 q raw *hing* worth Rs 942 crores.

**1.2. Saffron:** Another high value target crop is saffron, as country annually imports it to the tune of 100 t whereas its production is only 10 t that too in Kashmir region. The institute developed corm production technology, which had been the major impediment in its extension. Thereafter, using ecological niche modelling with 103 environmental variables, the institute identified potential locations all across the country to introduce saffron. Trials have been conducted in last four years in multiple locations in HP and other states. Quality of the produce was at par with that of Kashmiri saffron and was even better in some aspects viz., amount of crocin and picrocrocin.

**1.3. Zero-calorie Natural Sweeteners:** As the world working towards betterment of health and fitness, there is a huge need of natural, high potency and low or zero-calorie sweeteners over conventional dietary sweeteners in the food and beverage industries. Currently, global natural sweetener need has been estimated around

*CSIR-Institute of Himalayan Bioresource Technology , Palampur (HP)-176061*

**For Correspondence*

USD 39,100 million. Therefore, stevia and monk fruit plant as sources of natural sweeteners have attracted the world attention due to intense sweetness.

**1.3.1 Monk Fruit** (*Siraitia grosvenorii*) is known for safe source of low calorie sweet compounds, mogrosides. These are cucurbitane-type triterpene glycosides, 300 times sweeter than sucrose and has been approved by the US-FDA. CSIR-IHBT introduced monk fruit first time in India through NBPGR-ICAR, New Delhi. The institute developed nursery raising techniques and successfully established plantation at the Institutional Experimental Farm. A team of scientists is working on good agricultural practices, varietal improvement and developing green process technology and product development from monk fruit with a focus to bring the products in the market on commercial scale.

**1.3.2 Stevia** (*Stevia rebaudiana*), is a perennial sweet herb of Paraguay widely known for the presence of sweet-tasting and low-calorie diterpenesteviol glycosides(SGs) present in its leaves which are about 300 times sweeter than sucrose. The current requirement of stevia as food ingredient projected to be 8,507 tonnes. CSIR-IHBT has developed a complete agronomy package for stevia cultivation, an improved cultivar "Him Stevia"and post-harvest management practices. The institute has also standardized green process for production of SGs with proper quality and safety standards. Using standardized package of agrotechnology,20-25% improvement in yield has been achieved with average annual yield of dry leaf of 35-40 q/ha, bringing annual net return of Rs. 2.40-3.00 lakhs/ha.

**1.4. Low Chilling Apple in NER:** Traditional, apple cultivation in the country is mainly confined to Himachal Pradesh and Jammu & Kashmir and in small scale in Uttarakhand and Arunachal Pradesh. In other NER region it was not grown mainly due to its unmet need of chilling hours. The institute took initiative to introduce low chilling apple varieties in NER in the last 3 years through NERCORMP. The apple was planted in 150 locations covering 62.5-acre area in Mizoram and Meghalaya, Manipur and Arunachal Pradesh. The production and quality of apple was excellent and growers earned handsome returns.

**2. Aromatic Crops Empowering Farmers of the Himalayan States:** Wild marigold (*Tagetes minuta*) is a high value aromatic crop with good market size in perfumery, food and flavouring industries. It has emerged as an alternative crop solution to wild animal menace. CSIR-IHBT through Aroma mission has brought about 420 ha area under wild marigold cultivation in Himachal Pradesh, Jammu & Kashmir, Uttarakhand and north east regions with an employment generation of one over lakh mandays. This scientific intervention has provided assured annual benefit to the tune Rs. 1.50-2.00 lakhs/ha to the growers. In the year 2019-20, 6.49 tonnes oil production was achieved with a revenue of Rs. 5.19 crores, which enhanced the farmers' income by 2.5-3 times over traditional crops. It made the state to secure top position in tagetes oil production in the country. In addition, the institute also introduced other potential aromatic crops viz., lavender (net return: Rs. 2.5 lakhs/ha/year), rosemary (net return: Rs. 2.0 lakhs/ha/year) and German chamomile (net return: Rs. 2.7 lakhs/ha/year) in suitable locations in the hilly states.

**3. Floriculture Changing the Livelihood Landscape of Himachal Pradesh:** The institute promoted cultivation of floriculture crops tulips, lilium, gerbera, calla lily, marigold and carnation by way of developing improved varieties, cultivation practices and extension activities in Himachal Pradesh, Jammu & Kashmir, Punjab and Uttarakhand

for the benefit of farmers. Techno-economic aspect of lilium cultivation in Lahaul valley by third party, National Productivity Council, New Delhi, revealed that the net returns were about 5.0 and 6.67 times higher than that from the traditionally grown vegetable crops peas and potato, respectively. Recently, CSIR has launched floriculture mission to harness its potential in high income generation from small holding to boost livelihood and develop varieties as import substitute. Floriculture clusters have also been developed with MSME ministry.

4. **Integrating Apiculture with Floriculture and Aromatic Crops:** The honey market in India is estimated to reach Rs. 28,057 million by 2024 at CAGR of 10.2%. The institute integrated bee keeping with cultivation of aromatic and floriculture crops and undertook development of "Flow Hive" for efficient and hygienic honey extraction along with CSIR-CSIO, Chandigarh and demonstrated successfully in the field. Annual honey production/hive to the extent 30-35 kilograms has been achieved. In addition, the institute has developed numerous value added products from honey.

5. **Rehabilitation of Medicinal Plants for Cultivation and Sustainable Utilization:** The institute took initiatives to improve the availability medicinal plants including rare, endangered & threatened (RETs) such as *Sinopodophyllum hexandrum, Picrorrhiza kurroa, Fritillaria roylei* and *Trillium govanianum* through captive cultivation, gene bank creation, varietal improvement alongwith their agro-technologies to increase productivity and profitability per unit land area and conversion of RET status to the non-RET status. Elite plants of *Picrorrhiza kurroa* and *Fritillaria roylei* were multiplied through tissue culture technique and sent back to their natural habitat with an aim to sustainably use them for developing value added products and promoting entrepreneurship around them.

6. **Hydroponics and Aeroponics – the Modern Systems of Cultivation:** The market of these systems is projected to grow at a CAGR of 12.1 per cent by 2025. The start-ups have opportunities for the production of nutrient enriched spices and high value crops. In this facility, institute has successfully developed cultivation protocols of high value cut-flower and high value spices where assure advantages of short cultivation cycle and high quality disease-free crops. Spices like oregano, parsley and basil and medicinal plants viz., *Picrorhiza kurroa* and *Valeriana jatamansi* were being cultivated through this technology by the two entrepreneurs.

7. **Promotion and Utilization of Bamboo**: Institute maintains large germplasm of various bamboo species and generates planting material through micro and macro propagation for demand based supply. For value addition, the institute developed technology of edible food products, *Agarbatti* sticks, bamboo charcoal and some technology on bamboo fibre. Some of the technologies have already been transferred for empowering the beneficiaries and the products are in markets. The institute has supplied 5 lakh plants to 12 edible bamboo species and supplied to 15 states across the country.

8. **Value Added Products for Boosting Profitability of Tea Industry**: Boosting profitability and addressing labour scarcity were the major concern of tea industry. The institute facilitated Kangra tea industry with its GI status and mechanization of farm operations, which resulted in income enhancement by 3 times. The institute developed various value added products for secondary grades of tea and transferred to the industry and entrepreneurs, as described as follow:

**8.1.** **Tea-based Concentrates:** Ready-to-serve teas are high-end value added products. Process developed to prepare concentrates from green and black tea with refreshing taste and natural health attributes of tea. These concentrates can be reconstituted with hot as well as cold water. The tea concentrates were unsweetened tea and free from additives, preservatives and artificial flavors or colors. Global market of tea concentrates and ready-to-drink teas is USD 76 billion.

**8.2.** **Tea Vinegar:** The global market for vinegar was USD 800 billion in 2018 and growing at CAGR of 5.7%. CSIR-IHBT standardized vinegar production technology using two step fermentation, alcoholic and acetic acid fermentation, using specific technology. The product contains natural antioxidants and organic acids produced during fermentation and lacks any added chemicals and preservatives.

**8.3.** **Tea Wine:** Tea wine is low alcoholic beverage with high quality. Each ml of the wine contains 400-600 µg of trolox equivalent antioxidants. Wine can be made sweet and dry on demand with varying alcohol content ranging between 9-15%. It can be prepared using under-utilized fruits along with tea. The wine is a self-preservative herbal product with better valuation on maturation. Estimated global market of wine is USD 302 billion with an annual growth of over 5 %

**8.4.** **Tea Based Hand Sanitizer:** The institute developed alcohol-based formulation of hand sanitizer with alcohol content as per WHO guidelines. The formulation contains antimicrobial tea extract and lemon grass oil natural aroma. The sanitizer is an herbal product, free from parabens, triclosan, phthalates and synthetic fragrance. The Institute transferred this technology to 6 different industries/entrepreneurs.

**8.5.** **Herbal Green and Black Tea with Added Ayush Recommended Ingredients:** Tea being rich in antioxidants is known for antimicrobial properties. Panacea status of tea has been corroborated with scientific evidence. When tea is blended with other Ayush recommended herbal ingredients, its powerful immunity boosting further improves. Herbal teas have been developed using Ayush recommended ingredients, The products have been developed by entrepreneur from Mandi, H.P. under CM start-up scheme at CSIR-IHBT.

**8.6.** **Tea Based Natural Soaps:** Keeping in view the rising demand of safe hand wash in this corona virus pandemic period, the scientists at the CSIR-IHBT developed natural soap both in cake and liquid form. The soap composition provides effective antifungal, antibacterial, cleansing and moisturizing benefits with natural saponins. It does not contain any mineral oil, SLES (Sodium laurethsulphate) and SDS (Sodium dodecyl sulphate) and animal fat. Patch test revealed no irritation with its use. Further, antidandruff activity and antifungal and antibacterial skin were scientifically validated.

**8.7.** **Tea Catechins:** Tea catechins are high value antioxidants with nutraceutical properties. The global market of polyphenols is estimated to reach USD 210 million by 2022 with a CAGR of 15%. CSIR-IHBT has developed green technology for catechins production from fresh tea leaves. The product is free from toxic chemicals and solvents and has shelf life of catechins is 12 months. The technology has been transferred to two parties.

**9.** **Vitamin D2 enriched Shiitake Mushroom:** Shiitake is an edible and medicinal mushroom, rich in vitamin D precursor ergosterol. The institute standardized improved captive cultivation technology that has shortened its production time to 2.5-3.0

months from 8-12 months with yield of 0.5-0.6 kg per 1 kg dry weight of dry substrate. In addition, photo-conversion experiments were used to enrich shiitake mushrooms with optimized Vitamin D2 concentration to meet the 100% RDA with 350 mg powder. Vitamin D2 enriched shiitake powder may be used as sachet or to prepare a range of value-added products like pickles, soups, energy drinks, etc.The technology has been transferred to 4 parties. In addition, under the SFURTI programme of the ministry of MSME, 3 organized clusters have been empowered with the technology in Sikkim with a total project cost of Rs 7.35 crore benefitting 750 growers.

## II. FOOD AND NUTRACEUTICALS

CSIR-IHBT has developed a range of health benefitting nutraceutical formulations using green technology and have transferred them to the entrepreneurs. Given below is the details of some of the famous products:

1. **Nutraceutical Formulation for Cartilage Health:** Over 15% of Indian population affected by osteoarthritis. The market for these products is expected to touch USD 10.1 billion by 2024 at 8.1% CAGR. The institute has developed a nutraceutical formulation based on traditionally known Himalayan plants (*Cissus quadrangularis* and *Vitex negundo*) and tested using animal models to manage bone disorders, especially in elderly population.

2. **Canning Technology for Ready-to-Eat Foods:** It is an indigenous technology for commercial production of ready-to-eat foods, free from additives and chemical preservatives. The technology was used for successful revival of traditional ethnic foods such as *Kangridham* (an ethnic cuisine of Kangra region of HP) with shelf life of 12 months and retention of the original aroma, taste the prebiotic effects health benefits. Process also standardized for Ayurvedic *Kichadi* (a mix of rice and pulses) and *Halwa* (a sweet dish made of semolina, flour and other similar ingredients).

3. **Ready-to-Eat Crispy Fruits and Vegetables:** For preventing post-harvest loses of precious fruits and vegetables due to inadequate storage and processing facilities, CSIR-IHBT developed technologies for crispy fruits and vegetables production. The crispy products retain near to original nutrition, texture, taste, aroma and colour. There is no added preservatives or additives and the need no refrigeration for storage.

4. **Gluten Free Foods from Buckwheat:** Buckwheat, a gluten free pseudo-cereal, grows in cold deserts areas of Himalaya. The Institute has developed value added ready to eat foods products from buckwheat such as puffs noodles, bars, pasta and extruded snacks. These products are free from additives and chemical preservatives. Such products are boon for the people suffering from celiac disease.

5. **Iron and Zinc Enriched Spirulina based Bars:** This ready to eat bars were developed using spirulina for fortification of iron and zinc with different food matrices such as peanut, sesame and cereals. The bar meets at least 20% of recommended dietary allowances (RDA) of iron and zinc and 8% RDA level of beta carotene (pro-vitamin A) per serving. This product is very useful for children, adolescent girls, pregnant and lactating mothers.

6. **Iron Enriched Fruit Bars and Candies:** This cost-effective ready to eat fruit bars and candies address micronutrient deficiencies. These products have been developed from natural bio-resources such as crop residues and spice mixes, provide 25-30% RDA of micronutrients per serving (30 g). These and are free from additives and preservatives and are beneficial for children, adolescent girls, pregnant and lactating mothers.

7. **Multigrain High Protein Mix:** The product is developed for addressing protein and energy malnutrition. Made from nutrient dense ingredients such as pulses, millets, cereals and pseudo-cereals, the product can be consumed with milk or water or fruit juices, or as a protein fortifying food ingredient in breads and ready to eat foods. It provides 200-250 Kcal energy and 10 g protein per serving (50g), and meets 22% RDA of proteins, 10% of dietary fibre and 15% of Iron and calcium.

8. **Protein and Fibre Enriched Cereal Bars:** A low cost technology using 100% natural ingredients like wholegrains, millets, pulses, dehydrated fruits and nuts. The RTE bar provides 150 -200 Kcal energy and 6-8 g protein per serving (40g) and meets at least 20% RDA of protein and fibre.

## III. ENZYME FOR INDUSTRIAL DEVELOPMENT

India imports 80% of industrial enzymes. CSIR-IHBT has isolated and purified a unique thermostable superoxide dismutase (SOD) from a cold desert plant *Potentilla atrosanguinea*, and successfully produced it in a bacterial system. The enzyme has applications in food, cosmetic, agriculture, and pharmaceutical sectors. Technology transferred to M/s Phyto Biotech, Kolkata. Another enzyme L-asparaginase with no glutaminase activity is in process of upscale production and bioprocess development for commercial application. It has applications in food processing and possess promising anti-cancer activity.

## IV. WASTE MANAGEMENT: Technology for Night Soil and Organic Waste Degradation in Cold Hilly Regions

In the Himalaya's cold desert region, composting of night soil and organic waste is a major havoc. CSIR-IHBT has developed "Compost Booster", a ready to use formulation for rapid degradation of human, animal and kitchen waste. The formulation contains cold tolerant efficient hydrolytic bacteria with plant growth promoting potential and suitable carrier materials that accelerates composting process, reduces foul odour and enhances the compost quality. In 2019, 180 kg "Compost Booster" was distributed among nine households of three gram panchayats in Lauhal valley. With increased demand and popularity of the product, in the year 2020, 1-tonne capacity booster was distributed among 100 beneficiaries across 17 villages of 4 gram-panchayats of the valley.

## V. OTHER POTENTIAL TECHNOLOGIES

In addition, there are several other technologies which have been developed by the institute and successfully transferred to industrial partners for production of products and their marketing. These include –

(i) Natural colour and dyes from the Himalayan flora and products developed around it, like herbal multi-colourlipsticks

(ii) Eco-friendly technology for converting raw cellulosic biomass into textile fiber

(iii) Bioplastic (polyhydroxyalkanoates) from Himalayan glacial bacteria

(iv) Technology for production of biofertilizers for replacing chemical fertilizers

(v) Herbal incense cones from waste flowers

(vi) Value addition to underutilized fruit crops of the Himalaya like sohiong (*Prunus nepalensis*) from Meghalaya and sea-buckthorn in cold desert regions and developing range of products of nutraceutical importance, instant energy, fruit syrup, concentrates, ready-to-eat canned products etc.

**Some concerns to be addressed for promoting entrepreneurship**

- Cultivation of region specific crops needs support for planting material, processing facilities, proper network of quality evaluation and assurance as per market need.
- The entrepreneurs need a definite marketing system and buy-back guarantee for ruminative returns.
- Creating SHGs of small and marginal farmers, establishing networks, linkages with line agencies and FPOs and promoting e-marketing can boost entrepreneurship.
- Maintaining brand value need proper storage, transport and market outlets would be fundamental.

# Value addition in rapeseed - mustard and other oil seed crops

**Anubhuti Sharma and P.K. Rai**

**Abstract:** The present oil-industry in India is mainly concerned as manufacturers of oils and fats. Fat is an important component of diet and serves a number of functions in the body. Fat is a concentrated source of energy and it supplies per unit weight more than twice the energy furnished either by carbohydrate or protein. There is an urgent need to consider various ways and means of manufacturing value-added products (e.g. oleochemicals, surfactants, soaps, sauces etc.) from vegetable oils and other parts of the crop. Mustard greens have spicy, peppery Dijon mustard flavor and slightly peppery in taste. There are numerous varieties of mustard greens, ranging in leaf size and shape and color from green to red to purple. The most common type is bright green with a frilly, ruffled texture. This beautiful color and texture is yet another great reason to include mustard greens into your cooking as it provides better nutrients. The main products that are derived from oils and fats and their utilization are listed in this article.

**Introduction:**

Many components of human diet, previously overlooked, are now considered to play an important role in the prevention and treatment of important diseases. Over the last decade, disease preventing food and ingredients (called nutraceuticals) have written some success stories. Today, the most important nutraceutical formulations contain vitamins, with antioxidant properties, oligosaccharides, bioactive peptides, phenolic compounds, glucosinolates and other products.

Rapeseed-mustard (*Brassica* spp.) is the third important oilseed crop in the world after soybean (*Glycine max*) and palm (*Elaeis guineensis*). It contributes 28.6% in the total production of oilseed among the seven edible oilseeds cultivated in India and ranks second after groundnut sharing 27.8% in India's oilseed economy.

*B. juncea* is valued for its intense flavours and healing properties. This plant is cultivated mainly as an oil crop. It is a good bee plant. All over the world, mustard is used for its appetizing flavor and preservative value and the seeds are used largely for tempering food. Studies showed that cruciferous seed meals exerted protective effects against tumour formation and growth. Rapeseed mustard is reported to have a broad range of therapeutic effects, including antioxidant, anti-inflammatory, antitumour and anticancer effect.

The medicinal properties of rapeseed mustard are due to the presence of a variety of phytochemicals imparting the effect. In the laboratory, rapeseeds have been found to have very strong antioxidant activity, inhibiting cancer cell proliferation, decreasing lipid oxidation and lowering cholesterol. Mustard is available in the form of seeds, powders and oil. Recently, *B. juncea* has been explored for its biodiesel potential. Oilseeds plants have received considerable attention due to the role of endogenous bioactive compounds in human nutrition.

**Value addition in oily crops**

A number of value added products of oilseed crops are as follows:

- **Oleochemicals from erucic and behenic acids:**

  Oleochemicals based on the long chain fatty acids erucic acid and behenic acids, have special properties and may find increasing application in future. The Cruciferae family of plants, (rape & mustard) provide the most economical and readily available sourcs of erucic acid. Behenic acid is produced today by the hydrogenation of high erucic acid rapeseed (HEAR) oil and

*ICAR- Directorate of Rapeseed Mustard Research, Sewar, Bharatpur,*
*Ph. Nos. 05644-260379, 260495, Fax: 05644-260565,*
*E-mail: sharmaanubhuti98@gmail.com*

**Table 1 : Chemical composition of *B. juncea* (per 100 g)**

| Principle | % of RDA | Vitamins | % of RDA |
|---|---|---|---|
| Energy | 25% | Folates | 40% |
| Carbohydrates | 21% | Niacin | 30% |
| Protein | 46% | Pantothenic acid | 16% |
| Total Fat | 121% | Pyridoxine | 31% |
| Cholesterol | 0% | Riboflavin | 20% |
| Dietary Fiber | 32% | Thiamin | 67% |
| Electrolytes | | Vitamin A | 1% |
| Sodium | 1% | Vitamin C | 12% |
| Potassium | 16% | Vitamin E | 132% |
| Phyto-nutrients | | Vitamin K | 4% |
| Carotene-ß | 0.1% | **Minerals** | |
| Crypto-xanthin-ß | 0.05% | Iron | 115% |
| Lutein-zeaxanthin | 0.9% | Magnesium | 92% |
| | | Manganese | 106% |
| | | Selenium | 378% |
| | | Zinc | 55% |
| | | **Minerals** | |
| | | Calcium | 27% |
| | | Copper | 71% |

occasionally, of fish oils followed by fractionation. Thus, the optimal disposal of the by-product acids assumes economic importance.

❖ **In Industry as Lubricants and Surfactants**

Erucic acid as a worldwide market estimated 100,000 tonnes per annum, the market is growing very fast, due to the increased use of erucic acid for the production of rucamide lubricants, surfactants and cosmetics. In ICAR-DRMR genetic resources, high erucic acid genotypes of rapeseed and mustard are present, which could be exploited for the purpose. The presence of two different pathways for the conversion of oleic to linoleic acid and linoleic to linolenic acid suggests the possibility of genetic manipulation-of-one without affecting the other two fatty acids, for improving the quality of *Brassica* oil.

❖ **As detergents and alcohols**

The major end use is in detergent type alcohols and surfactants. Emphasis on 'green products' - products compatible with the environment - has encouraged increased interest in natural fatty alcohol derivatives in the detergent field. If growth continues woldwide for these natural raw materials, there will be a need each year for a new 40,000 tonnes fatty alcohol facility. Their biodegradability is viewed as a major advantage in areas where environmental concerns and regulations are increasing.

❖ **Biodiesel Industry**

Mustard seed oil is not currently a common biodiesel feedstock, but because it has the potential to be a cheaper feedstock than the two most common oilseeds used for biodiesel are (mustard and soybean), mustard oil biodiesel has been researched extensively at the University of Idaho. Rapeseed mustard is related to canola, but mustard can grow in drier areas and needs fewer pesticides and other agricultural inputs than canola. Therefore, it can potentially be grown more cheaply. Rapeseed mustard yields about 8 gallons of biodiesel per acre. Many biodiesel producers sell edible seed meal as livestock feed. However, the pungency adds value to the meal as a potential biopesticide. Rapeseed mustard seed meal can be used to inhibit weeds and pests,

which could make it valuable for the organic farming industry.

❖ **Soaps**

Saponified fatty acids have been the simplest surface active agents since ancient times. Various proportions of fatty acids are used to obtain a soap with good lather, water solubility and detergency.

❖ **Cosmetics and pharmaceuticals**

Oils like coconut, sesame, groundnut and castor oils have medicinal uses. They are also utilized in making pecialitysoaps like face and shaving creams and hair lotions. Vegetable oils function as emollients in creams and lotions. They serve as carriers of vitamins. Lecithins are excellent emulsifiers

❖ **Textile and leather industry**

Surface active compounds prepared by treatment of oils with sulfuric acid have been very important in imparting desirable softness or stiffness to fabrics. Turkey red oil is an important oil utilized in textile dyeing. Vegetable oils are used in fat liquorng of leather after chrome tanning treatment.

❖ **Soybean Meal**

Soybean meal is a good source of protein for poultry. It contains 40 to 48% protein. The amino acid profile of soybean meal is well balanced and is rich in lysine but deficient in methionine content. Soybean seeds have certain anti-nutritional factors like protease inhibitors, goitrogens and estrogenic factors that can affect the production performance of chicken. But they are all thermo-labile and can be destroyed by roasting, heating or autoclaving. An adequate balance of amino acids by substituting methinine to soybean meal can successfully replace even fish meal from poultry feeds.

❖ **Rapeseed mustard meal**

Three varieties of rapeseed mustard meal were tested in poultry feeds. They are mustard royal, brown or yellow meal and toria. Rapeseed mustard meal has an average crude protein value of 37% with more lysine and methionine contents than groundnut meal but its usage in poultry feeds is limited due to the presence of deleterious factors like glucosinolates, tannins, erucic acid, high crude fibre etc. Glcosinolates are potential goitrogens which cause enlargement of the thyroid gland, consequently reducing the performance of layers and broilers. The toxin sinapines, affects palatability of feeds and imparts a fishy flavour. The process of solvent extraction after initial pressing of the seed appeared to destroy the goitrogens an isothiocyanates and reduce the toxic effects of the cake. The tannins can be checked to some extent by addition of calcium hydroxide and sodium carbonate in dry form in diets.

❖ **Sesame meal**

Sesame meal contain 40% protein and 8% crude fibre. The protein is rich in arginine, leucine and methionine but low in lysine. Since the sesame meal is deficient in lysine its combination with soybean meal appears to be useful. Sesame meal has high calcium content but its availability is questionable because of phytate content in the hulls of the seed. The phytic acid reduces the availability of calcium and zinc from the diet. Nevertheless, the diet can be included in poultry diets upto 15% level in combination with other lysne rich oil cakes.

❖ **Mustard greens Indian products**

Mustard greens are prepared in India in an exceedingly traditional manner. People cook the sarson ka saag the type of curry prepared along with mustard greens only. Aside from this, mustard greens are usually cooked as the mustard greens dal recipe.

❖ **Mustard greens salad**

Mustard greens are utilized to prepare healthy and delicious salads. One of several well-known kinds of mustard greens salad is definitely the Salad of mustard greens as well as avocado. Mustard greens are not just included with the salad because of its nutrient benefits, but in addition mainly because it increases the attractiveness of the salad.

❖ **Mustard greens soup**

It is just a really hot and spicy soup that is great for the people throughout the springtime as well as in summer. This kind of soup can be created possibly with vegetables or perhaps a chicken base soup. It is just a very healthy soup.

❖ **Mustard greens southern recipe**

The southerners are usually in love with greens. mustard greens are probably the preferred veggie for people who live there. There are particular dishes which are prepared along with mustard greens within the south. A number of them are turnip greens, pea' greens and red plum vinaigrette along with mustard greens recipe.

❖ **Braised mustard greens**

It is just a traditional way of preparing mustard greens in the southern manner. Within this dish, the mustard greens need a long and slow cooking time, so that it' smoothly cooked. It features a high-content of salt and fat.

❖ **Pickled mustard greens**

This can be a scrumptious dish, mustard greens could be pickled and it may be stored for quite a while. It features an excellent taste, which makes it best to taste for a long period.

**Some common examples of value addition**

- A recently developed new vegetable oil derivative, Erucichem T6000, is a telomer derived from rapeseed oil. It is said to be a unique product which provides lubricity, oil thickening and is a blending agent for both plant and mineral oils in the manufacture of lubricants.
- High pressure lithium based greases derived from hydrogenated castor oil have been used for greater lubrication required for automotive and military use.
- Jojoba oil (which has received much attention as a substitute for whale sperm oil) derivatives have been used in automatic transmission fluid supplement.
- A variety of sebacic acid esters derived from castor oil has been used as plasticizers and lubricants for jet engines. Bis (2- ethylhexyl) sebacate has been found satisfactory for wide temperature range performance encountered by jet engines demonstrating outstanding ability to maintain lubricity under severe operating conditions.
- Erucamide, made from Erucic acid is a very important processing aid for olefin polymers namely polyethylene and polypropylene.
- Rapeseed and castor oil are widely used as lubricating oil. The popular castrol is a special blend of lubricating oil containing castor oil.

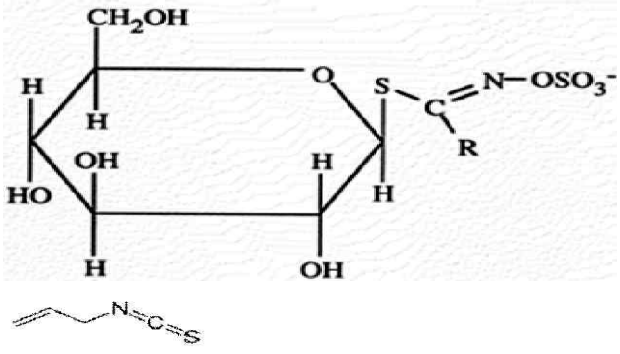
**Table 2 : Health benefits of different parts of rapeseed mustard:**

| Plant parts | Uses |
|---|---|
| Leaves | Antiscorbutic, diuretic, stimulant and stomachic, relieve headache, muscular and skeletal pains, diaphoretic. liniment for rheumatic pain antihelmintic, antidysentric, diaphoretic, fever and cold, for bladder inflammation or hemorrhage. |
| Seed | Rubefacient and stimulant, tumors in China, In Korea, these are used for abscesses, colds, lumbago, rheumatism, and stomach disorders, hypoglycemic, treatment of blisters in inflammatory neuralgic affections and for obstinate vomiting, antioxidant activity, seed paste is used in backache, arthritis, paralysis, oedema of the lungs and liver |
| Powdered seed | Antibacterial activity, internally used for hiccup, augments the appetite, It relieves the phlegm in cough, |
| Oil | Aphrodisiac, lubricant, hair oil, preservative, counterirritant, emetics in drunkenness and in poisoning, skin eruptions and ulcers, antimutagenic, colic, externally applied for arthritis, antiseptic and anti-inflammatory, seed oil, with salt is an effective gargle in dental infections and pyorrhea. |

| | |
|---|---|
| Seed residue | Cattle feed, fertilizer, |
| Other parts | Diuretic, for arthritis, footache, lumbago, and rheumatism, its decoction is useful in amenorrhea. |
| Roots | A galactagogue in Africa |
| Dried leaf and flower | A body odor repellent to mosquitoes, dengue fever |
| Total plant | In Java the plant is used as an antisyphilitic emmenagogue, Bronchitis, anorexia, dyspepsia, tumors, worm infestations and splenic disorders. |

❖ **Major chemical constituents of mustard:**

Members of family cruciferae contain many health promoting and potentially protective phytochemicals including folic acid, phenolics, carotenoids, selenium, glucosinolates and ascorbic acids. These bioactive compounds offer powerful, broad-spectrum supportfor protecting against the ubiquitous cancer provoking agent encountered every day in our environment mainly glucosinolateslucosinolates are the substituted esters of thio amino acids and methionine and cysteine are the major precursors for their synthesis.




Derivatives of the mustard constituent i.e. allyl isothiocyanate, forms the basis for toxic agents such as mustard gases of warfare and the antineoplastic nitrogen mustard.

A chemical reaction between the enzyme myrosinase and a glucosinolate known as sinigrin from the seeds leads to the production of allyl isothiocyanate. The main component of mustard oil is allyl isothiocyanate.

Allyl isothiocyanate serves the plant as a defence against herbivores. Since it is harmful to the plant itself, it is stored in the harmless form of a glucosinolate, separate from the myrosinase enzyme. Once the herbivore chews the plant, the noxious allyl isothiocyanate is produced.

There are a large number of unconventional oils, which can yield unusual non glyceride components which need to be evaluated for beneficial activity. Hydnocarpic and chaulmoogric oils which contain the unusual cyclopentenyl fatty acids were once used in the treatment of leprosy. While value addition of vegetable oils brings to mind uses in food industry, detergents, or derivatives which these oils can yield; it may be remembered that these oils have medicinal use and many Indian vegetable oils have been credited with medicinal properties.

# Processing of pulses and value addition

**Sandeep P. Dawange, Vikas Kumar, Sandeep Mann, Renu Balakrishnan, Yogesh Bhaskar Kalnar and Deep Narayan Yadav***

**Abstract :** Pulses are the edible seeds of pod-bearing plants that are widely grown throughout the world. India is the largest producer, consumer & Importer of pulses in the world (33% of the world area and 22% production). Pulses have a high protein content ranging from 20-30% and this makes them important in human food from the point of view of nutrition. In general, the protein content of pulses is more than twice that of cereal grains, usually constituting about 20 per cent of the dry weight of seeds. Because of this high protein content, they are also known as 'poor man's meat'. An alternative name for pulses is “legumes”, which are common in many parts of the world. About a dozen pulses are grown in India, more popular gram (> 40%), tur or arhar or pigeon pea (20%), moong (green gram), masoor (lentils), and urad (black gram). Tur, moong, and urad are mainly cultivated in *kharif* season and gram in *rabi* season. Madhya Pradesh, Rajasthan, Uttar Pradesh, Maharashtra, Andhra Pradesh, Telangana, and Karnataka are the major producers of pulses.

## 1. Introduction

To cope up with ICMRs recommendations of 45 g/day consumption of pulses, the country needed to produce 28.6 million tons of pulses in the year 2020. The total production of pulses in the country was 23.0 mt in 2019-20. Milling of pulses is a process of removal of outer husk/hulls and splitting the grain into two halves. There are about 15000 pulse mills in India with average processing capacities of 10–20 t/day. However, the traditional method of milling gives dhal yield of 65 to 72% only in comparison to 82-85% potential yield, and 12-20% produce is lost in the form of broken and powder formation. Table 1 depicts the milling output of pigeon pea in a major

**Table 1: Milling output of pigeon pea in major production states.**

| State | Fractions | Large scale (Commercial mill) | Small-scale (Village chakki) |
|---|---|---|---|
| | | Mean (%) | Mean (%) |
| Madhya Pradesh | Dhal | 71.4 | 62.6 |
| | Broken | 3.6 | 10.5 |
| | Powder | 13.0 | 11.0 |
| | Husk | 12.4 | 16.5 |
| Maharashtra | Dhal | 68.0 | 59.0 |
| | Broken | 5.8 | 12.0 |
| | Powder | 12.6 | 13.5 |
| | Husk | 13.4 | 15.0 |
| Uttar Pradesh | Dhal | 70.6 | 62.0 |
| | Broken | 4.1 | 10.2 |
| | Powder | 12.7 | 13.0 |
| | Husk | 12.9 | 14.4 |

*ICAR-Central Institute of Post Harvest Engineering & Technology, Ludhiana-141004*
**Email: deep.yadav@icar.gov.in*

production state. The minimization of post-harvest losses by means of increased milling efficiency is a challenge for the researchers and industry in the country.

**2. Milling of pulses:**

Dry pulse seeds have a tight and fibrous seed coat (husk or skin) that envelops the cotyledons, which often is indigestible and may have a bitter taste. In grains like cowpea and green gram, the seed coat is thin forming 8-10% of the grain, whereas in Bengal gram and tur, they are thick and constitute 10-14% of the grain. Milling of pulses is a process of removal of outer husk/hulls and splitting the grain into two halves. Dhal milling involves different unit operations, such as cleaning and grading, pitting, oil & water pre-treatment, tempering, drying, shelling and splitting, husk separation and grading, polishing, and packaging. These unit operations may or may not be performed according to the type of pulse, variety, ease of operation, and desired end-product quality.

**2.1 Cleaning and grading:**

The pulses received at the processing unit may contain foreign matter such as stones, clay particles, straw, chaff, and dirt. These have to be separated using an air screen cleaner. The size of grains may vary widely and it hampers the uniformity of treatment during processing. Use of ungraded lot for processing results in an inferior quality product. Grading of pulses can be done using sieves of different sizes.

**2.2 Pitting:**

Pitting or surface scratching is one of the basic unit operations before the application of any pre-milling treatments in pulse milling. Passing the seeds quickly through the roller mill results in scratches or cracks in hull and removal of waxy layer of seed coat and improves the absorption of pre-treatment agents. Generally, pulse dehulling machines are used for pitting operations.

**2.3 Pre-treatment:**

***a. Wet method/Conditioning with water:***

The cleaned grains are scoured or pitted in roller mills, and sprayed with water 5-10% by weight of the grain, and kept in a closed vessel for the water to be fully absorbed by the skin. The material is then dried in the sun. This process is used for conditioning of chickpea, lentils, lathyrus, pea and dried peas for further milling operation. Conventional methods of processing cause cup formation, more breakage and powdering of cotyledons, time-consuming and the edges of cotyledons break during splitting.

***b. Dry Method/Conditioning with oil:***

The cleaned and pitted grains are treated with vegetable oil (0.2 to 0.5%). The grains are dried in the sun and then conditioned by spraying water (about 4-5%). The conditioned grains are again dried in the sun before dehusking step. This process is used for pulses with hard-to-remove husk layer such as pigeon pea or red gram, black gram and green gram.

***c. Chemical treatment:***

The aqueous solution of various chemicals such as acetic acid, NaOH, $NaHCO_3$, $Na_2CO_3$, NaCl, etc is used for loosening the bond between hull and cotyledons of pigeon pea. Use of 5% v/w $NaHCO_3$ solution followed by conditioning for 4 h under shade, drying to 9.5% moisture content, and dehulling with abrasive mill results in dehulling efficiency of 75-78%. Soaking pigeon pea in acetic acid for pretreatment is adopted.

***d. Enzyme treatment***

This approach has been evaluated for partial hydrolysis of hull by enzymatic reactions to facilitate dehulling of pigeon pea. Solution of Crude enzyme produced by *Aspergillus fumigates* (NCIM-902) on wheat bran medium (0.03g enzyme protein for 100 g seed) is mixed with pigeon pea at 24% moisture content and incubated at about 45°C for 16 h. the pulses are dried to 9.5% moisture content followed by milling in an abrasive mill. This pretreatment results in 85-86% dehulling efficiency for pigeon pea.

***e. Hydrothermal treatment:***

Heating of pigeon pea for easy dehulling has been practiced in some parts of India for long time. The heat treatment-based pre-milling treatment process has been standardized by Central food

Technological Research Institute (CFTRI) India for pigeon pea milling. The process comprises of pitting, oil application and conditioning for 6-8 h, heating grains at 120-180°C in LSU dryer for some time. The grains are conditioned for 5-6 h in the drying bin, followed by heating grains again for some time and conditioning for 10-12 h in the drying bin. Dehulling of pre-treated pulses with abrasive mill results in 81-86% dehulling efficiency. Hydrothermal treatment of pulses to improve dehulling of pulses is still at the research stage and needs further investigations.

**2.4. Pulse dehulling and splitting:**

Dehulling is intended to loosen and remove the seed coat to produce polished seed whereas splitting is a cleavage of the two cotyledons to produce splits, popularly called dhal in India. Dehulling removes seed coat that contains a major portion of fibers and raffinose and thereby improves the appearance, texture, quality, and palatability and reduces the cooking time. About 80-90% of the total seed polyphenols are present in seed coat and the amount is greatly reduced by dehulling operation. Dehulling of pulses is done at around 10% moisture content irrespective of method of pretreatment employed. Most common commercial machine for pulse dehulling is emery-coated cylinder-concave system.

Depending upon the method of pretreatment used during the processing, the pulse milling methods as categorized as dry method and wet method.

**2.5 Dry milling process:**

The detailed process of dry and milling is given in Fig.1 and Fig.2 respectively.

**3. Infrastructure required**

For establishing the plant, one need to have a suitable location. Before deciding plant location, number of factors should be taken into consideration.

- The plot should be of adequate size for both present needs and future development.
- The plant should be close to public transport such as road or rail.
- Access to electricity and water is essential.
- Waste disposal should be considered while planning the plant location.
- The owner should coordinate all the works with local competent authorities in order to avoid any problems in future. The choice of plant location should also take into account the neighboring surroundings. For example, location near to a waste dump could lad to microbiological contamination caused by birds.
- Drains must be located appropriately in all processing areas. Slope must be adequate to ease the flow of waste material.
- Building should be comprised of sufficient space for work under adequate hygienic conditions i.e. an area for machinery, equipment, and storage, separate area for operations that might contaminate food, adequate natural or artificial lighting, ventilation nd protection against pests.
- There are many technical regulations concerning construction of buildings and processing halls e.g., outside walls, windows and doors should be constructed such that they are water, insect and rodent-proof.
- The inside walls of the building should be painted white or other light color and their surface should be smooth, fall-safe, corrosion-proof and easy to clean.
- Floors should be resistant to spillage of products, water and disinfectants. They should be slip-proof. 11. The work areas have to be in adequate size to enable hygienic processing and plant cleaning.
- Plants and machines must not be positioned against the wall, for example if there is a risk of the wall- side becoming dirty.
- The arrangement of the rooms and work areas must be such that hygienically clean areas and products within them are separate from unclean areas.

- As far as possible, product flow should be arranged so that no intersections occur. Ideally, incoming products, raw materials, storage, processing, packaging and dispatch should take place step by step from one end of the plant to another without products rom different production stages intersecting one another.
- Water supply must be adequate and sufficient for processing and cleaning purpose. Water must be tested/ analyzed at least twice in a year in an approved laboratory for compliance with drinking water standard.
- Toilet rooms must not have direct access to processing area and sufficient for personal use. Toilets walls and floors should be made light colored preferably tiled.
- Operations should be separated as necessary. There are clear advantages in minimizing the number of interior walls since this simplifies the movement of materials and employees, simplified supervision, and reduces the area of wall that needs cleaning and maintenance.

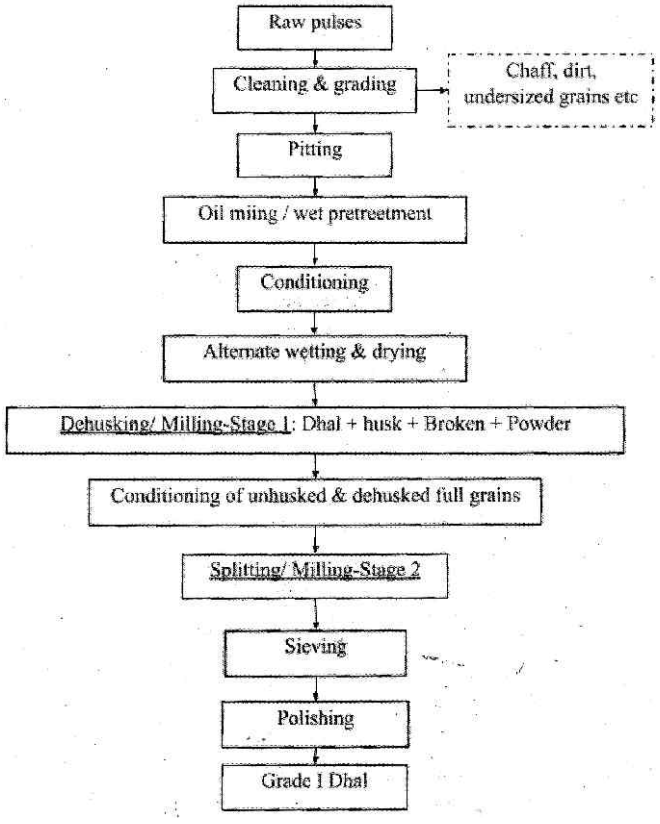



**Fig. 1: Flow chart for dry milling of pulses**

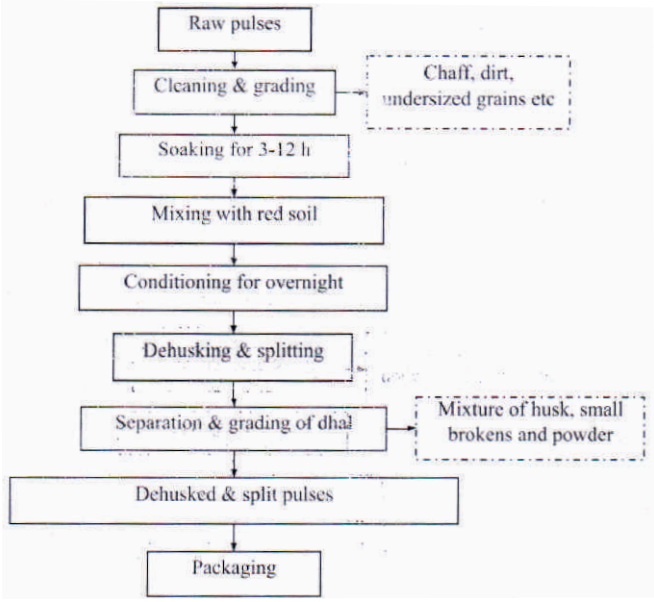



**Fig. 2: Flow chart for wet milling of pulses**

## 4. Machinery and Equipment

Selection of milling equipment's depends on features like product to be prepared, raw material availability, capacity of machine, power source, ease and safety in operation, material of fabrication (SS or MS), manpower requirement and ease in repair and maintenance. The machinery and equipments required for starting a pulse processing unit is given as below:

### 4.1. Air Screen Cleaner cum Grader

The air screen cleaner cum grader is the basic cleaner in all seed processing plants. It uses three cleaning principles viz. aspiration, scalping and grading. A common air screen cleaner for processing consists of two air blasts and two screens. The screens used in combination with air blast perform better cleaning and separation operation. This machine works on the principle of differences in size and weight of seeds. It has three sections: aspirator, in which light material such as husk and chaff are removed from the pulse mass; scalper in which good seed are dropped through screen openings but larger material is carried over the screen into a separate spout and grader, in which good crop seed ride over screen openings while smaller particles drop through. The capacity of machine is 400 kg/h. It is suitable for cleaning and grading of almost all types of pulses like chickpea,

**Table 2: Different machineries and equipment used in pulse processing**

| S.No. | Name of Machine | Purpose |
|---|---|---|
| 1. | Air screen cleaner cum grader | Remove coarse and fine/ lighter impurities and grading |
| 2. | Destoner | For removing the stones or heavy impurities |
| 3. | Tray Dryer | For the conditioning (drying) of pulses |
| 4. | Moisture Meter | Moisture measurement |
| 5. | PDKV Mini Dal Mill | Milling, pitting, de-husking splitting and grading |
| 6. | Weighing Balance | Measuring weight |
| 7. | Pedal operated sealing machine | For sealing of package |

pigeon pea, green gram, black gram, kidney bean, pea, lathyrus, lentil etc.

**4.2. Destoner**

Destoner is used for removal of heavy foreign contaminants like stones, metallic and glass pieces, etc. from grains and seeds of all crops. It works on the principle of weight/gravity separations with stratification by positive pressure fan. This machine consists of a perforated deck. The air coming through the deck from bottom stratifies the materials while the

reciprocating action of the deck separates the heavy material from lighter particles. The heavier material moves upward while the lighter material flows downward. The capacity of machine is about 400-500 kg/h.


**Fig. 3: Destoner**

**4.3. Tray Dryer**

Tray dryer is a conventional drying equipment with enclosed insulated chamber and the trays are placed on top of each other in rack/trolley. It is used to remove moisture from bulk solids by evaporation. The working principle of drying is forced convectional heating due to continuous circulation of hot air. The material to be dried is placed on trays and the heat transfer is by circulation of hot air by electric heaters or steam in radiator coils. Blower fans are installed inside to ensure proper circulation and transfer of heat.

**4.4. Moisture Meter**

Moisture meter is used to measure the moisture content in the sample. The quality of all agriculture products like grains, pulses and oil seeds depends on their moisture content. An optimum moisture content of 10-12 per cent is required for milling and storage of pulses by dry and wet method. Therefore, moisture measurement is a crucial step prior to milling. Moisture content is determined by the principle of measuring the electrical conductivity of the material, which always is proportional to the percentage content of the moisture.

**4.6. Mini Dal Mill**

Mini dal mill consists of dehulling unit, sieve unit, screw conveyor, blower, cyclone separator and splitter. The hopper is provided for feeding the grain lot. The horizontal type abrasive roller is provided for dehulling of grain with provision of inlet and outlet controls. The roller is covered by a metal sieve with specific clearance. The mixture of husk, powder is separated


**Fig. 4: PDKV Mini Dal mill**

from grains by cyclone separator and the part of powder and husk is taken differently through concentric sieve. The balance dehulled mixture falls down by gravity on the reciprocating sieve unit provided with two sieves. The upper sieve separates grain with gota and lower one separates dal. The brokens are collected below sieves on pan. Three different outlets are provided for separation of dal, gota and brokens. The grain with gota is fed to the screw conveyor where either oil or water can be uniformly applied to the materials. The capacity of mini dal mill is 125 kg/h.

***Settings of Dal Mill***

1. **Foundation:** Foundation of the machine should be permanent.
2. **Belt tension adjustment:** Belt should be adjusted tightly such that when belt is pressed from the two ends there must be a gap of 10-15 mm.
3. **Hopper inlet opening:** Hopper inlet opening for different type of pulses is given below:

a) Masoor: 8mm

b) Urad and Moong: 1mm

c) Chana: 10-11mm

4. **Air adjuster/controller:** If dal comes out of the cyclone then open/adjust the air inlet. 5. Sieve adjustment: Different sieve sizes used for different type of dals.

a) Masoor: 2mm

b) Chana: 3.5mm

c) Black gram: 2.5mm

d) Arhar: 3mm

**4.7 Weighing Balance**

Weighing balance is used for weighing of substances/materials. Electronic weighing systems are used in industries and business establishments for weighing materials accurately.

**4.8 Pedal Operated Sealing Machine**

Sealing machine is used to seal the packages of thermoplastic. This machine can be hand operated or pedal operated. Efficient sealing of packages prevents leakage and helps in hygienic selling of product. It is the process of sealing one thermoplastic to another using heat and pressure. The direct contact method of heat sealing utilizes a constantly heated die or sealing bar to apply heat to a specific contact area or path to seal or weld the thermoplastics together.

**5. Mini dhal mills**

Different organisations of the country have visualized and developed the concept of small capacity dhal mill. These include PKV mini dhal mill, TNAU dhal mill, CFTRI dhal mill, Pantnagar dhal mill, CIAE dhal mill, IIPR dhal mill, ICRISAT dhal mill, IARI dhal mill, etc. Capacity of these dhal mills varies between 50-200 kg/h after specific oil pretreatments. However, all the developed dehulling machines are based on principle of impact and abrasion, which comprises of emery roller-concave system (except IIPR dhal mill in which steel plate and hard rubber is used). With varying methods of pretreatment, all the machines performs the dehulling of pulses at around 10% moisture content. Depending upon the type of pulses and techniques adopted by the millers such as methods of pre-treatment and milling machinery used, the recovery of dhal varies from 60% to 75%.

By increasing the use of dhal mills at small-scale processing units, it is easy to control milling losses, thus, higher dhal recovery potential could be realized. The establishment of dhal milling units in rural catchments has the potential to promote rural entrepreneurship, generate employment opportunities, enhance rural income and ultimately, prevent migration to the urban area.

**6. Value added products:**

***a. Cooked pulses:*** Whole green lentils, mung bean are used in soups and casseroles. They are popular in majurra, a lentil and rice dish, as well as lentil soup and green gram - rice porridge are eaten in summer. Also used to make patties or loaves. Soups, stews, casseroles such as cassoulet in France and Boston baked beans.

***b. Fermented food products:*** Pulses are fermented to make variety of traditional foods such as *temphe* (traditional Indonesian food), *miso* and *natto* (traditional Japanese foods). In India, pulse based popular fermented foods are *idli* and *dosa*. In addition, chickpeas are fermented, deep-fried, toasted, baked, and puffed to make a range of products.

***c. Flour/Aata:*** Green gram flour is widely used to make noodles, breads, biscuits, mung bean cake and pappad. Lentils flour is combined with cereal flour to make breads and cakes. Replacing 5-10% of wheat flour with green gram bean flour can improve the mixing properties of dough in bread-making. Lupin flour (5-20%) can be added to wheat flour to make bread, biscuits or pasta. Uncooked beans are ground with other ingredients to make falafel. Desi chickpea splits are ground into besan flour.

***d. Fresh pulses:*** immature wrinkled seeds, green chickpeas are used as fresh vegetable or frozen.

***e. Snack foods:*** Pulses can be used as a base for snack foods, fried to make snack foods and yellow and green pea flour is used to produce extruded and fried snack products. Kabuli chickpeas are fried or roasted to make snack foods. Whole blue peas are used to make Mushy Peas, pies and other dishes. These are also used in soups, curries, casserole and salads. In India, they are also used to make sweets and desserts. Deep-fried lentils are used as a snack food. Whole beans are used in soups, purees, baked goods, snack foods and in breakfast foods. Lentils are also used in commercial invalid and weaning foods.

***f. Split/dhal:*** Most yellow and green dried peas, desi chick pea, red lentils are split and boiled with spices to make dhal in India. These are also used by food manufacturers to make pre-prepared soups (e.g. canned pea and ham soup) or as a food ingredient (e.g. baby food). Also soups, purees, casseroles, patties and loaves are prepared from dhal.

***g. Sprouts:*** Pulses can be sprouted for use in salads, stir-fries or pickling. Sprouts have better nutritional profile as compared to raw pulses because they contain bioavailable vitamins, proteins, digestible carbohydrates and phytochemicals with reduced anti-nutritional factors.

**7. Government Schemes**

**7.1 Ministry of Finance scheme**

**a) Mudra Bank Scheme**

Pradhan Mantri Mudra Yojana provides financial assistance for setting up and development of business. For entrepreneurs who are in initial stage of business development, this scheme provides subsidy up to Rs.50000 and for those who has already set up the business it provides subsidy above Rs.50000 up to Rs.5 lakhs for further expansion. Entrepreneurs and co-operatives can apply to this scheme. Application by eligible individuals can be sent to the nodal officer of MUDRA scheme in the respective regions. The details of Nodal officer can be found at http://www.mudra.org.in/Nodal-Officers-MUDRA.pdf.

**b) NABARD Scheme**

Producer Organizations Development Fund (PODF) provides financial assistance for production, aggregation, processing and marketing. Marketing federations and co-operatives can apply to this scheme. Individuals can apply through banks.

**7.2. Ministry of Agriculture**

**a) Post-Harvest Technology and Management**

This scheme provides financial assistance for setting up units using post-harvest technologies, management and value addition. Ministry extends financial assistance in the form of grant-in-aid to farmers, SHG's, co-operator and contingency expenditure @100% for purchase of machinery. Co-operatives and farmers can apply to this scheme. Application by farmers and co-operatives can be sent to Joint Secretary (M&T) of Department of Agriculture & Co-operation, New Delhi.

**b) Pradhan Mantri Kisan Sampada Yojana (PMKSY)**

The Ministry has formulated the Scheme for creation of Infrastructure for Agro Processing Clusters as a sub scheme of Central Sector Scheme - "PRADHAN MANTRI KISAN SAMPADA YOJANA (PMKSY)". The scheme aims at development of modern infrastructure to encourage entrepreneurs to set up food processing units based on cluster approach. The scheme is to be implemented in area of horticulture / agriculture production identified through a mapping exercise. At least 5 food processing units with a minimum aggregate investment of Rs. 25 crore will be set up in the Agro-processing cluster. These units may be set up by the promoters and associates of Project Execution Agency (PEA) and by other entrepreneurs. The extent of land required for establishing the agro-processing cluster would depend upon the business plan of Project Execution Agency (PEA), which may vary from project to project. At least 10 acres of land for the project shall be arranged by the PEA either by purchase or on lease of at least 50 years.

**8. Machinery Manufactures / Suppliers**

**8.1 Air screen cleaner cum grader**

1. Agro Asian Industries, 135, Saha Industrial Growth Center, HSIIDC Industrial Area, Saha, Haryana 133104 Contact: Neha Verma, 092545-00008.
2. Osaw Agro Industries Private Limited, P.O. Bag 5, Agrosaw Complex, Jagadhri Road, Ambala Cantt, Ambala, Haryana 133001 Contact: Sanjeev Sagar (Managing director), 0171-2699547. 3. GD Agro Industries, Opposite Industrial Area, Jagadhri Road, Ambala Cantt, Sarsehri, Ambala-133001, Haryana, Contact: Manmeet Singh (Proprietor), 098128-28777, 080680-94768.
4. Goldin (India) Engineering Company, 10/11 Last Lane, B.I.D.C Estate Gorwa, Vadodara-390016 Gujarat, Contact: MD Patel (Managing director), 098242-40130, 097254-63436.
5. Bharat Agro-Tech Industries, R-12A, IInd Floor, Uppals Southend Sohna Road, Sector 49, Gurgaon-122018, Haryana, Contact: Nikhil Goyal (Marketing Manager), 080494-72515.
6. Ang Enterprise, No. 747- 9, GIDC Makarpura, Vadodara -390010 Gujarat, Contact: Gurjit Singh (Partner), 080489-44825.

**8.2 Destoner**

1. Osaw Agro Industries Private Limited, P.O. Bag 5, Agrosaw Complex, Jagadhri Road, Ambala Cantt, Ambala, Haryana 133001 Contact: Contact: Sanjeev Sagar (Managing director), 0171-269 9547. 2. Goldin (India) Engineering Company, 10/11 Last Lane, B.I.D.C Estate Gorwa, Vadodara-390016 Gujarat, Contact: MD Patel (Managing director), 098242-40130, 097254-63436
3. Rajlaxmi Engineering Corporation, 32 Imanwada Chowk, near Imamwada police station, Great Nag Rd, Nagpur, Maharashtra 440003 Contact: Manoj Hemrajani (Proprietor), 0712-2745172

4. S.P. Hi Tech Industries, 117/2, Near Asaram Road, Village, Budhpur, Delhi, 110036 Contact: Sandip Sharma (Proprietor), 095806-45270.
5. Shri Viratra Engineering, Neelkanth Minechem, Barmer, Highway Road Narnandi Village, Jodhpur-342001, Rajasthan. Contact: Pokar Ram Chaudhary (Proprietor), 080487-63279.
6. JD Magnetic Impex, 106, Suryam Sky, Swaminarayan Park, Opposite Karnawati Mega Mall, Vastral, Ahmedabad-382418, Gujarat, Contact: Hitesh Kumar (Owner), 080487-11415.

**8.3 Mini Dal Mill**

1. Maa Durga Plastic Products, J-19, Phase 3, M.I.D.C., Akola-444104, Maharashtra. Contact: Parag Shah (Partner), 080430-45960.
2. Rising Industries, Teghoria, Loknath Mandir, Jhowtala Ghosh Dutta Para, Kolkata-700157, West Bengal. Contact: A.K. Kuila (Managing Director), 080716-83325.
3. Shri Viratra Engineering, Neelkanth Minechem, Barmer, Highway Road Narnandi Village, Jodhpur-342001, Rajasthan. Contact: Pokar Ram Chaudhary (Proprietor), 080487-63279.
4. Kamdhenu Agro Machinery, Plot No. 6, Near Power House, Wathoda Road Wathoda, Nagpur-440035, Maharashtra. Contact: Mahesh Hatwar (Director), 080487-62202.
5. Flour Tech Engineers Private Limited, Plot No. 182, Sector 24, Faridabad-121005, Haryana. Contact: Suman Gupta (Manager), 080487-62010.
6. Manvi Engineering & Fabrication, 169B, Chota Bangada Main Road, Akhand Nagar, Indore-452001, Madhya Pradesh. Contact: Rahul Pal (Proprietor), 080487-28205.
7. Shankar Engineering Corporation, 18, Rabindra Sarani, Poddar Court, Gate No. 2, 3rd Floor, Room No.335, Kolkata-700001, West Bengal. Contact: Pratik Garg (Business Head), 080716-77003.
8. Rajlaxmi Engineering Corporation, No.32, Immambada Chowk, Great Nag Road, Nagpur-440003, Maharashtra. Contact: Manoj Hemrajani (Proprietor), 080487-64042.
9. Deccan Farm Equipment Private Limited, C-35, M.I.D.C., Shiroli, Kolhapur-416122, Maharashtra. Contact: Bharat Patil (Director), 080719-32872.
10. Kissan Agro Industries, No. 115, Village Holambi Khurd near Railway Station, New Delhi-110082. Contact: Ashwini Panchal (Sales Manager), 080718-03699.
11. Osaw Industrial products Pvt. Ltd., The Oriental Science Apparatus Workshops, 42, Complex, Jagadhari Rd, Sonia Colony, Pooja Vihar, Ambala Cantt, Haryana 133001 Contact: 0171-2699267, 2699222, 2699102, 2699347.

**8.4 Moisture Meter**

1. Western Agro Tech Equipments, Plot No. 1, Dashmesh Colony, Jarot Road,ambala city, Haryana, Ambala 133104, Haryana Contact: Gopal Chauhan (Proprietor), 080460-78823.
2. Globe Technics, C-68, Indrapuri, Near 2 No. Bus Stand, Near Movie Magic Cinema Hall, Loni, Ghaziabad 201102, Uttar Pradesh, Contact: Vishal Sharma (Proprietor), 080488-02192.
3. Green Agritech Equipment, No. 34, Hari Nagar, Behind B. D. Flour Mill Ambala Cantt, Behind B.D. Flour Mill, Gandhi Nagar, Ambala-133001, Haryana, India Contact: Vijay Verma (Prop.), 080480-61446, 098961- 18188.
4. Komal Enterprises, LGF, L-7, Sardar Hari Singh Complex, Subhani Khera, Telibagh, Near Hanuman Mandir, Telibagh, Lucknow-226002, Uttar Pradesh, India Contact: Amit Srivastava (Prop.), 080484-29245. 5. JNR Electronics, 1787, 2nd Floor, Electrical Market, Bhagirath Palace, Chandni Chowk, New Delhi-110006, Delhi, India Contact: Kartik Sansi (Prop.), 080460-44737.

6. Tunix Corporation, 520, MS 1- A, Opposite Mall Godown Road, Indore GPO, Indore-452007, Madhya Pradesh, India Contact: Anita Vishwakarma (Prop.), 080488-61730.

**8.5 Tray Dryer**

1. Airco Instruments & Machinery, New GH-6/60, Paschim Vihar, New Delhi-110087, Delhi, Contact: Somarajan K.S (Proprietor), 080470-17427.
2. Keeman Marketing Associates, No. 331, Dynamic Center, Zone 1, M.P Nagar, Bhopal-462011, Madhya Pradesh, Conatct: Mandeep Singh (Proprietor), 080494-43018.
3. Hitech Lab Solutions, Gala No. 66, 67, Ashirvad Industrial Estate, Near Ram Mandir Station, Jogeshwari West, Mumbai-400097, Maharashtra, Contact: Jagdish Ghia (Partner), 080488-36102.
4. BS Jagdev and Sons, House No. 6555, Street No. 5, Gill Market, Daba Road , New Janta Nagar, Ludhiana - 141003, Punjab, Contact: Gurdeep Singh (CEO), 080489-49121.
5. Sumitra Enterprises, 2099/38, First Floor, Room No. 102, Sewak Chambers Naiwala Karol Bagh, New Delhi 110005, Contact: Vijay Alagh (Director), 08048078832.
6. Ravindra Engineers, Plot No. 123, HSIIDC Industrial Area, Manakpur, Mandepur, Yamunanagar-135003, Haryana, Contact: Vijay Dhiman (Director), 080470-14489.

**9. Training Facility**

Training facility regarding pulse processing is available in the following institutes:-

1. ICAR- Central Institute of Post-harvest Engineering and Technology, Ludhiana-141004 (Punjab). Contact: Director, 0161-2313101

   Email: ciphetludhiana1989@gmail.com, ciphet.director@gmail.com
2. ICAR-Central Institute of Agricultural Engineering, Nabi Bagh, Berasia Road, Bhopal - 462038 (Madhya Pradesh)

   Contact: Director, 91-755-2521000

   E-mail: director.ciae@icar.gov.in
3. ICAR-Indian Institute of Pulses Research, Kanpur-208024.

   Contact: Director, 91-512-2580986, 2580994, 2580986

   E-mail ID- diriipr.icar@gmail.com, director.iipr@icar.gov.in
4. Punjab Agricultural University, Ludhiana-141004 (Punjab).

   Contact: Registrar, 91-161-2401794

   E-mail:- registrar@pau.edu
5. Dr. Panjabrao Deshmukh Krishi Vidyapeeth P.O. Krishi Nagar, Akola -444104 (MS) Contact: Vice chancellor, 91-724-2258093

**10. Conclusion**

In future, there lies a tough challenge of insuring availability of pulses to the ever growing population of the country. This could be adequately addressed by increasing the production and reducing the losses during post production handling, storage and processing. The loss of edible portion during processing either by traditional of modern methods is 10-22% which is huge loss in terms of its monetary value. The technologies for processing and value addition to pulses developed in the country need to be popularise for greater adoption by individuals as well as industry. The skill development through training and entrepreneurship development programme may play vital role trickling of technologies to grass root and adoption in production catchment. At present, the pulse processing industry need to focus on by-product utilisation and their valorisation. This will have direct bearing on environmental pollution and other associated problems. The bio-refinery for complete utilisation of biomass need to be looked into for potential solution. The infrastructure in the country needs considerable strengthening to meet the present and emerging challenges in processing and value addition of pulses.

# Millets processing and value addition: Status, scope and challenges

**M.K.Tripathi[1*], D. Mohapatra[1], S Deshpande[1] and Anil Kumar[2]**

Millets show significant role in nutritive diet in many areas of the world. Despite the statement that millets are nutritionally superior to other cereals, their participation as food in diet is still restricted to the poor people. Millets are rich source of carbohydrates, energy and protein, fat, iron, calcium and dietary fiber, which helps to prevent many health diseases. The environmental changes, water shortage, population increase, reducing yields of major cereals, make a challenge to nutritionists and researchers to study the potentials of production, processing and using another prospective food sources to end the poverty and hunger. The present paper reviews different post-harvest technologies, processing and convenience food products prepared from millets.

**Introduction:**

Millets are group of small seeded cereal crops of variable sizes, belonging to poaceae family, grown all over the world. They are one of the oldest foods known to humans and possibly the first cereal grains to be used for domestic purposes. Their presence in Asia can be dated before 10,000 years. The presence of fossilized kodo grains in the Harappa civilization indicates the importance of these millets in that era. Millets mostly migrated from western Africa and reached Asia, and domesticated along with the wild rice. Foxtail millet (*Setaria italica* L.) probably originated in southern Asia and is the oldest of the cultivated millets. In China, records of culture for foxtail and proso millet extend back to 2000 to 1000 BC. Today millets ranks as the sixth most important grains in the world, sustain one third of the world's population and is a significant part of the diet in northern China, Japan, Manchuria and various areas of the former Soviet Union, Africa, India, and Egypt. These crops are lifelines for millions of population in Africa and India and thrive in the hot dry climates that are not conducive to growing other grains such as wheat and rice. As per FAO's report for the year 2018, India is one of the largest producers of millets with a production of 10.28 MT with as many as ten crops under cultivation and contributed about 36% of world millet production for the year 2016.

The millet group includes sorghum (*Sorghum bicolor* L.), pearl millet (*Pennisetum glaucum*), finger millet (ragi) (*Eleusine coracana*), kodo millet (*Paspalum scrobiculatum*), little millet (*Panicum sumatrense*), foxtail millet (*Setariaitalica*), and barnyard millet or proso millet (*Panicum miliaceum*). Among all the millets, pearl millet is the most cultivated millet, grown predominantly in India and parts of Africa. The top 10 millet growing states of India are Rajasthan, Maharashtra, Gujarat, Uttar Pradesh, Haryana, Karnataka, Madhya Pradesh, Tamil Nadu, Andhra Pradesh and Jammu & Kashmir. Some important potential health benefits of eating millet are as:

- Magnesium in millet can help to reduce the effects of migraines and heart attacks
- Niacin (vitamin B3) in millet can help to lower cholesterol, body tissue repair
- Phosphorus in millet helps with fat metabolism, lowering blood pressure, risk of heart disease, cholesterol, preventing cancer and cardiovascular diseases; reducing tumour incidence
- Fibre and whole grain helps in preventing asthma, delaying gastric emptying; and supplying gastrointestinal bulk, help to lower the risk of type 2 diabetes, protect against breast cancer to cite a few. Some important millet and their medicinal values are given in table 1.

[1]*ICAR-Central Institute of Agricultural Engineering, Bhopal, MP-462038, India*
[2]*Rani Lakshmi Bai Central Agricultural University, Jhansi, Uttar Pradesh, India*
**Corresponding author; manoj.tripathi1@icar.gov.in*

**Table 1 : Important millets and their medicinal values**

| Millet | Therapeutic status |
|---|---|
| Pearl millet | • High amounts of magnesium and potassium control blood pressure and relieve heart diseases<br>• Magnesium also reduces respiratory problems and migraine attack<br>• High phosphorous content helps in bone growth and development in kids, High dietary fibre causes slow release of glucose and more suitable for diabetic patients,<br>• Phytic acids reduce the cholesterol levels of body<br>• Hypo allergic properties make it a suitable diet for infants, lactating mothers, elderly and convalescents. |
| Finger millet | • High amounts of phenolic acids have anti-ulcerative properties, lower blood sugar level and cholesterol, anti-cataractogenic<br>• Germinated seeds improved haemoglobin level in infants, protection against mucosal ulceration, epithelialisation, increase the synthesis of collagen,<br>• High amount of calcium strengthens bones<br>• Lecithin and methionine reduce cholesterol level by eliminating excess fat from liver<br>• High amount of iron protects from anaemia, |
| Foxtail millet | • Strong antioxidant, metal chelating and reducing powers, they reduce toxicity caused by xenobiotics and toxins in the body<br>• High amount of proteins and essential amino-acids helps in building body tissues. |
| Proso millet | • High amount of copper enables the body to form red blood cells, helps maintain healthy bones, blood vessels, nerves, and immune function, and it contributes to iron absorption<br>• Sufficient copper in the diet may help prevent cardiovascular disease and osteoporosis<br>• Magnesium reduces respiratory problems and migraine attack, potassium control blood pressure and relieve heart diseases |
| Kodo millet | • Phenolic compounds have anti-ulcerative properties, lower blood sugar level and cholesterol<br>• Magnesium and potassium control blood pressure and relieve heart diseases and also reduces respiratory problems and migraine attack |
| Barnyard millet | • The richness of phenolic acids, tannins, phytates and dietary fibres show anti-mutagenic and anti-carcinogenic properties<br>• High amounts of dietary fibre reduces risk of colon cancer and oesophageal cancer<br>• Phosphorous content helps in bone growth and development in kids. |
| Little millet | • High amounts of iron helps to preserve many vital functions in the body<br>• High amounts of zinc help in enzymatic reactions, immune function, wound healing, Protein and DNA synthesis and normal growth and development of the body. |

Millets were indeed one of the oldest foods known to humans but they were discarded in favour of wheat and rice with urbanization and industrialization. Other millets that need we will also be focusing also are Brown top Millet (*Brachiaria ramosa*) and Crap grass (*Digitaria cruciata*). Millets are now being relooked as a viable option to live healthy life due to their anti-diabetic and anti-hypertension properties

as these ailments are spreading faster with more and more urbanization, low physical activity and modern life style. Millets act as prebiotic feeding micro-flora in our inner ecosystem. The regular intake of millets keeps hydrated our colon and resultantly avoid being constipated. The high levels of tryptophan in millet produce serotonin, which has soothing and calming effects to our moods. Magnesium in millets can help in reducing the effects of migraines and heart attacks, whereas, niacin (vitamin B-3) is helpful in lowering blood cholesterol. Millet consumption decreases triglycerides and C-reactive protein, thereby preventing cardiovascular diseases. All millets have high antioxidant activity and are gluten free and non-allergenic.Millets crop can play a major role in achieving nutritional security (Fig. 1).

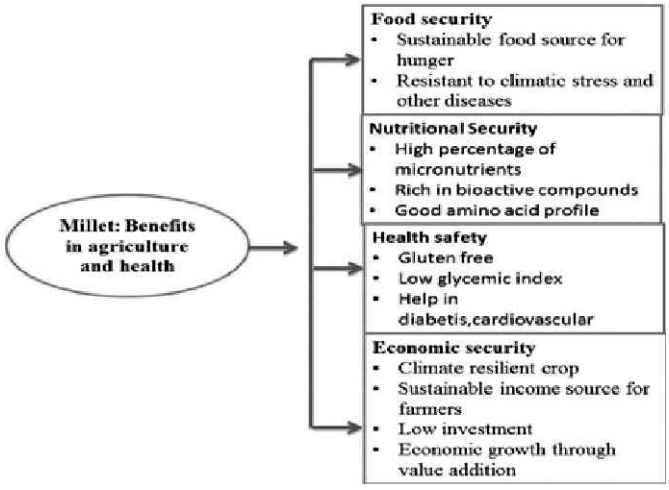



**Fig. 1 : Millet - Benefits in agriculture and health**

## Anti-nutritional compounds responsible for food limitation

The millets also contain some anti nutritional content such as tannins, trypsin inhibitor, and phytic acids which affects the protein, carbohydrate digestibility and mineral bioavailability. Some of the millets contain hydrocyanogens, which are highly toxin to both human and animals. These problems can be addressed through suitable plant breeding program, proper agricultural practices and processing.

## Utilization of millets in Current scenario

Traditionally, millets were the staple diet of Indians, especially for rural and lower income households. They have been increasingly replaced by rice and wheat since the 1960's driven by the relatively high productivity gains (Green Revolution) and government's food security strategy focusing on these crops compared to coarse grains. Coarse grain is purchased by the poultry and animal feed sector and other industrial users (e.g., starch and ethanol). Before the green revolution in India in the mid-1960s, small millets made up more than 40% of all cultivated grains in an agriculture industry that contributed more than 50% to the Indian GDP. In the last two decades, the importance of millet as food staples, particularly in India, has been declining due to various factors, including rising incomes, growing urbanization, and government policies. More than 50% of the millet production is currently finding its way into alternative uses as opposed to its consumption only as a staple.

## 4. Problems linked with millets:

- Poor digestibility of millet starch due to the presence of hard peripheral endosperm layer
- Inferior organoleptic qualities of millets due to the presence of anti-nutritional factors like tannins that impart dark colour, bitterness and astringency in the prepared food, thus affecting the sensory quality of millet based food
- Tannins also bind with proteins during wet cooking, forming insoluble complex, thus limiting the protein absorption
- The high contents of phytic acid (0·50–0·70%) in millets present grounds for concern, in view of its interference with several minerals
- Presence of inherent anti-nutritional compounds such as alpha amylase inhibitor, which reduce starch utilization
- Dry sorghum grains contain small cyanide.
- Manual dehusking or processing of millets with hard pericarp involves lot of drudgery, especially for the womenfolk.
- Lower shelf life of processed or semi-processed products from millets is due to heightened lipase activity
- Pearl millet and sorghum grains are prone to insect damage during storage.

- Lack of infrastructure and awareness with regards to processing, value addition and storage of millets

**Need of processing for food uses**

The external tough seed coat of millets is associated with flavour and non accessibility of processed millet products are the major causes for fewer acceptance of millet foods**.** There are many types of machinery available for processing of many cereals but poor availability for millets. The nutrient and technological properties of minor millet grains have a number of occasions for processing and value addition to use as next generation foods and useful in satisfy the consumers. Currently preparation skills have changed generally due to deficiency of time and with the introduction of the fast food industry. The processing of millet comprises partial separation and alteration of some major constituents of millets as germ, starch-containing endosperm and protective pericarp. In general, primary process include in cereal is commonly the separation of pericarp and occasionally the germ from the edible portion.

**Processing to enhance quality of millets**

**Milling/debranning**:

Debranning or decortication of millets improves the storability by removing the antinutritional factors that are mainly clustered in the outer layer of the millets. The limitation is however, the millets are stripped off with the antioxidants and minerals, which are mostly present in the bran layer.

**Extrusion cooking**:

During extrusion cooking process, the HTST treatment degrades the anti-nutritional factors and improves nutritional availability. During the extrusion process; the 9 product is cooked and ready to eat extruded product can be prepared from this technology.

**Popping/ Roasting**:

Dry-heating like popping and roasting reduces the phenolics and phytate content. This is also a ready to eat product without any additional salt or oil.

**Nixtamalization**:

The term 'nixtamalization' refers to the removal of the pericarp from any grain using an alkaline process. The basic process of nixtamalization begins by cooking whole grains in water with lime and steeping the cooked grains for 12-16h in large tanks. Hot alkaline treatment of sorghum reduces the tannin and phytate content and improves the nutritional bioavailability.

**Steam flaking**:

Steam flaking also reduces the anti-nutritional factors and improves protein bioavailability. Steam flaking which involved soaking, steaming and flaking gelatinizes the starch can be used for preparing a variety of food products.

**Sprouting/ germination**:

During sprouting or germination, enzymes are activated causing reduction in tannin and phenolic and leaching of cyanogenic glucoside (cyanide). The process may take some time and other microbial growth is possible during this process.

**Malting**:

During malting both germination and heat treatment inactivates the lipase and reduces the phenolic compounds and cyanides thereby improving the nutritional bioavailability and reducing the toxicity.

**Fermentation**:

These problems can be addressed by some suitable pre-treatments such as fermentation. Fermentation reduces phytic acid, cyanogenic acid, polyphenolics content, starch, and long chain fatty acid, increases the total sugar and reducing sugar, improves protein extractability and digestibility. Moreover during lacto bacillus fermentation (LAB) fermentation, tannase enzyme is produced, which breaks down the condensed tannins; thus, reducing the chance of tannin-protein complex formation during wet cooking.

**Modified starch**

Millet starches naturally have polygonal and spherical starch granules. Millets starches have not been studied as expansively as other cereal starches. Similarly, studies on millet starches over the years

have focused on the physicochemical characteristics, with minor information on its structural characteristics. Under cooking, the native starch has been studied to loose its clarity, form gel and endure syneresis while storage due to the property of retrogradation which results in deteriorated quality of food products. Since, it has been reported that starch in its native state shows low shear stress resistance, thermal decomposition, high retrogradation and syneresis, its applications are restricted and to surmount this problem starch is being modified.

**Millet based value added food products:**

The consumption of millets as food is limited in Africa and Asia. Currently the demand for millet use as food increase which can be attributed to the increase in demand from Africa, where food request increased several folds in past twenty five years. In Asia, the food demand has decreased over the past twenty five years. In some counties the reasons for move away from millet consumption can be attributed to the varying policy environment and led to losing their economic advantage in production. Besides, several value added products, health mixes and beverages have been developed, solely from millets or as important ingredients in many of the popular snack foods (Fig.2 and Fig3). Since processed millets based products have limited shelf life, efforts have been made to make the millets more nutritive with enhanced shelf life.

**Conclusion**

Millets are nutritionally rich as compare to other

**Fig. 2 : Millet based value added products**

**Fig. 3 : Millet based fermented ready to cook (RTC) and Ready to eat value added products**

cereals, so product development by processing and using millets have unquestionable views with respect to health benefits, nutrition and quality. Millets are cheaper but less expedient to use as it is not so popular among the people and its use in food is limited to only poor and traditional people. There are different methods and processes for preparing the products from millets only and mixing the millets with other ingredients, these methods can same as that of wheat and rice and may be different from that as the physical chemical properties of the millets are different from the other cereal grains. It can also be an alternative to the other cereals like rice and wheat, but is not fully established among the population. Entry and establishment of significant number of micro, small and medium food enterprises in the small millets value chain is the key for sustained and dynamic growth of consumption of millets. However, these enterprises are in need of customised support to thrive in the context of nascent market development for small millets.

# Development of aroma industry in Bundelkhand

**Rambir Singh**

India has always been a land of olfactory indulgence, where aromatherapy, incense and ittar have existed since ancient times. The earliest scents used were the healing scents introduced through Ayurveda, which recommended the use of aromatic herbs and fragrant plants for mental well-being, beauty, treatment of ailments, hygiene and age-control which are well known even today. The traditional fragrance industry in India has seen vast changes in the recent years with the introduction of technology and wider usage. The Indian fragrance industry is one of the largest in terms of production, consumption and at present, the fragrance market is set to grow and offer innumerable opportunities for new entrants to grow in this market. India being the leading country in the world with rich diversity in flora and fauna with its 15 Geo- climatic zone. India can produce organic fragrant raw materials which have great demand in the world. Considering its close linkages with grass-root economics, it can reboot Indian economy from ground level.

## Introduction

Global fragrance & flavour industry is worth $24.10 Billion and India contributes approximately $500 million. However, growth rate in India is approximately 11% in the last few years but is projected to grow exponentially in the upcoming years due to rising personal care, brand awareness, increasing disposable income, growing demand in middle class people and affordable price of fragrance in the form of mass perfumes & deodorants. Worldwide, approximately 300 important natural fragrant raw materials are in use. Out of these, only 50% are cultivated and rest are found in wild habitation (e.g. Nagrarmotha, Kewra etc). Out of the cultivated raw materials, 110 cultivated natural fragrant raw material cover 95% of the current global consumption is in fragrance & flavour. Out of these, there are 31 for which India is well known globally and there are nearly 21 which are grown but not to a level for global significance. India has made global impact with essential oils of Menthol mint, Sandalwood, Jasmine, Tuberose and spices.These fragrance chemicals are predominantly used in household products such as cleaners, hand &dish wash liquids, laundry care & fabric softeners, wipes, and aqueous dyes. After the COVID-19 outbreak, consumers are showing interest toward healthy and hygienic lifestyles and adopting various healthy & hygienic habits, such as repetitively washing hands, washing of vegetables & fruits, sanitation of outside stuff, and regular cleaning of floors, due to the fear of viruses and diseases.

Bundelkhand region of Central India is one of the least developed regions in the country. The region comprises of 07 districts (Jhansi, Lalitpur, Mahoba, Hamirpur, Jalaun, Banda and Chitrakoot) of Uttar Pradesh and 07districts (Datia, Niwari, Teekamgarh, Chatarpur, Panna, Sagar and Damoh) of Madhya Pradesh. Since the industrial development in the Bundelkhand region has been very poor, agricultural produce is the principal source of livelihood. The region is largely rain fed with poor irrigation facility. Further adding to the misery of the people, the region has been facing the problem of drought since last many years. Due to the poor agricultural production and no other alternative sources of livelihood, large numbers of people are migrating from Bundelkhand region. As most of the Bundelkhand is rainfed, low rainfall during past several years has put the crop cultivation highly vulnerable and at risk. The frequent crop failures and increasing cost of labour and agri-input has drastically reduced the farm incomes. Keeping in view all odds due to geographical and environmental factors, alternative means of livelihood for the farmers of Bundelkhand region are required.

*Department of Horticulture, Aromatic and Medical Plants, Mizoram University (a Central University), Aizawl, Mizoram*
*Earlier worked as Associate Professor at Bundelkhand University, Jhansi. Email : sehrawat_r@yahoo.com, Mobile No. 9473583251*

Bundelkhand University in collaboration with CSIR-CIMAP, Lucknow; CSIR-IIIM, Jammu and FFDC, Kannauj has implemented a project on 'Cultivation and Processing of Aromatic Crops' in Bundelkhand. The project has been funded by Department of Biotechnology, Govt. of India for 03 years from 2018-2021. The selected aromatic crops have inherent potential to tolerate high degree of drought stress and are suitable for Bundelkhand. These crops apart from being tolerant to various biotic and abiotic stresses are not affected by livestock or grazing animals, further protecting the crops from the prevalent system (*Anna Pratha*) quite common in Bundelkhand. These crops have the potential to enhance the income of the farmers by more than 50%.

A nursery of selected varieties of lemongrass, rosagrass, vetiver and ocimum has been established at the agricultural farm of the Bundelkhand University. A distillation unit for demonstration and training of farmers have been installed and is being used for production of essential oil. The spent material left after steam distillation and extraction of essential oils, is grounded to powder form and is used for preparation of other value added products like *Agarbatti, Dhoopbatti* and *Havansamgri*. An automatic machine has been installed at the University farm for making *Agarbatti*. The distillation units have been installed in all 14 districts of Bundelkhand and the automatic *Agarbatti* making machine has been in selected clusters. The aromatic crops are under cultivation in approximately 1500 acres in the 14 districts. Bundelkhand is proposed as a hub of production the aromatic oil through further extension of this project activity. The agreements are being established with buyers to procure the essential oils form the farmers of Bundelkhand. The future prospects of aroma based industry in Bundelkhand are very bright. The next focus will on value addition of essential oil as well as spent material for enhancing farmer's income and rural prosperity in Bundelkhand.

Following main aromatic crops are being cultivated in Bundelkhand for the development of aroma industry:

1. **Lemongrass/Nibughaas (*Cymbopogan flexuosus*)**

**Uses-**The oil is used in high grade perfumery and synthesis of aroma chemicals. Citral is the main constituent of lemongrass oil.

**Plant description-**It is a perennial aromatic grass, oil is extracted from the leaves, if harvesting is delayed then flower appears in the plant. There is no oil in flowers, however some of new varieties does not flower.

**Climate and soil** -Warm and humid climate is best for cultivation of lemongrass, the north Indian sub-tropical conditions are best for cultivation of lemongrass. Well drained fertile soil with pH range 7.0-8.5. It can be cultivated in rainfed condition also. It is also used for soil conservation purpose.

**Propagation** - It is recommended to grow it by slips obtained by splitting the well developed clumps. In irrigated condition 37,000-40,000 slips/ha are required with the spacing of 60 × 45 cm and non-irrigated condition 70,000-75,000 slips/ha required with spacing of 45 × 30 cm.

**Planting and preparation of field -** Planting is done in the last week of June-July depending upon the onset of rains. It may be also planted in Feb-March, under irrigated condition spacing line to line 60 cm and plant to plant 45 cm. Before transplanting 2-3 ploughing are necessary, in non-fertile soils plant spacing is reduced as compared to irrigated condition.

**Manure and fertilizers -** NPK @ 150:60:40 is required per ha per year. Entire amount of P&K is applied at the time of last ploughing in 1st year and in subsequent year after the summer harvesting. N is applied in splits thrice per harvest, under non-irrigated condition quantity of fertilizer should be reduced to half.

**Irrigation -** Generally, less irrigation required in lemongrass. However, in summer 4-5 irrigations and 2-3 irrigations are sufficient in winter and rainy seasons. After every harvesting irrigation is required.

**Harvesting and yield -** Harvesting is done by cutting the grass with help of sharp implement, approximately six inches above the ground level. In irrigated conditions, 200-250 kg oil per year/ha and under non irrigated condition on the basis of two harvesting, 100-120 kg/ha/year, and has market price of Rs.1000-1200/kg oil.

2. **Palmarosa (*Cymbopogan martinii*)/Rosagrass (*Cymbopogan nardus)***

**Uses-**The oil is used in high grade perfumery and synthesis of aroma chemicals. Mainly, Geraniol has rosaceous odour and used on substitute of rose.

**Plant description-** It is a perennial grass having height of 100-150 cm with yellowish flower. Both flower and leaves contains essential oil. In irrigated conditions, 3-4 harvests and non- irrigated conditions two harvests can be taken in a year.

**Climate and Soil -** Clear warm weather with low relative humidity is necessary for optimum growth in north India. Sandy loam with adequate drainage are ideal for palmarosa cultivation, water logging may cause death of the plants. In non irrigated and non productive soil Palmarosa can grow up well.

**Propagation**-Through seeds, 5-6 kg seeds with > 80% germination is required for1 ha. In broadcasting method 10-12 kg seed required for 1 ha. Nursery for 1 ha can be raised in 100 sq.m area. After 2-3 ploughing, field is ready for transplantation of nursery in normal condition spacing 60 × 30 cm and in non-irrigated condition spacing 30 × 30 cm is ideal.

**Manure and fertilizer-**In irrigated condition, 150:50:50 kg NPK is required per ha per year, Nitrogen applied after every harvesting. Half the doses of fertilizers are required in non-irrigated condition.

**Irrigation-**First irrigation is applied just after transplanting, if rainfall, then no need of irrigation. The water requirement is less for this crop. In winter and summer season, 3-4 irrigation is sufficient. However, irrigation must follow every harvesting.

**Harvesting and yield -** Palmarosa harvested about 4-6 inches above the ground at 50% flowering stage. In rainy season harvesting can be done without flowering. Irrigated condition: 125-150 kg oil/ha/year, non-irrigated condition 75- 80 kg/ha/year. After distillation oil can be stored in aluminum bottles or HDPE cans. The oil should be moisture free during long term storage.

3. **Tulsi (*Ocimum basilicum)***

**Uses-** Oil used in pharmaceuticals, soap, perfumery industry and aroma therapy. Methyl chevicol, Linalool, Citral

**Cilmate and Soil -** Tropical, sub-tropical and rainy season with 22-28$^0$C and humidity 75-80 is best for cultivation. Well drained soil with normal fertility is ideal for cultivation.

**Propagation -** Seed requirement through nursery is 500 gm seed/ha. Nursery may be raised 25-30 days before transplanting.

**Plantation and preparation of field -** Transplanting at spacing of 45 × 30 cm in the month of June & July month.

**Manure and fertilizers -** 10-15 ton well decomposed manure or 5 ton vermi-compost, 40:40 kg phosphorus and potash applied in last ploughing, 80 kg Nitrogen applied in 3 parts at regular interval of 20 days.

**Irrigation -** 1st irrigation is applied immediately after planting and subsequent irrigations as and when required.

**Harvesting and yield -** Harvesting should be done after 3 months of planting when plants are in full bloom. Herb yield 200-250 q/ha, oil yield-100-125 kg/ha. Market rate of oil – Rs. 700-1000/kg.

**Conclusion**

Global Aroma Chemicals Market size exceeded USD 5 billion in 2020 and is estimated to grow at a CAGR of 6% between 2021 and 2027. Rapid growth in packaged food consumption in developing economies and the proliferation of personal care products in the emerging countries is anticipated to drive the business growth. The

natural aroma chemicals market surpassed USD 2.4 billion in 2020 and is anticipated to witness a CAGR of around 6.5% from 2021 to 2027. The consumers are demanding greater transparency in the products they purchase including knowing where their products come from and what their ingredients are. Additionally, growing environment concerns and awareness among the population, the use of environment-safe products by youngsters, and greater knowledge about wellness will drive the demand for natural products over the forecast timeframe.

# Alternative cash cropping : A method of prosperity and farmer's empowerment of Bundelkhand region

**Rohit Peardon and Dr. Lavkush Dwivedi***

India is a leading country in terms of agriculture production and export of various agriculture products. It is expected to surpass the $60 billion mark of agriculture export very soon which will bring up a strong agriculture hold for India globally. Amid many agriculturally productive regions, the central India region is still struggling with the issues related to agricultural growth despite of having so many Projects, Central & State level Institutes, and Government schemes to develop this region. Being industrially underdeveloped the agriculture remains the major occupation of this region, which is due to little rainfall, often droughts, conventional farming, poor yields and lack of advanced agricultural practices has become an occupation of little interest. Youths are gradually detaching from it and are forced to migrate to developed cities in search of mere jobs of a few thousand rupees.

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Currently, farmers are conventionally practicing the wheat, pulses, mustard, and some vegetable crops in Bundelkhand region, whereas there are enormous possibilities to introduce new crop varieties which can enhance the development. The alternative cash cropping of medicinal, fruits, oil-yielding, and fibre plants which can survive in lesser water requirement and make agriculture a lucrative occupation in this region. As every region have some special resources likewise entire Bundelkhand is naturally blessed with several medicinal plants like *Acacia catechu* (Khadira), *Asparagus racemosus* (Shatawari), *Boswellia serrata* Shalaki), *Desmodium gangeticum* (Shalaparni), *Gymnema sylvestre* (Gudmaar), *Hemidesmus indicus* (Anantmoola), *Oroxylum indicum* L. Kurz, *Pluchia lanceolata* (Rasana), *Tribulus terrestris* (Gokshuru), *Urariapicta* (Prishniparni), *Withania somnifera*

*Innovation Centre, Bundelkhand University, Jhansi*
*Corresponding author-*lavkush@bujhansi.ac.in*

(Ashwagandha), *Writia tinctoria,* etc. Therefore, practicing alternative, intermittent, or intercropping of above medicinal plants for commercial therapeutic use may diminish agriculture setbacks and conserve the plants' diversity of this region.

Apart from this, prominent fruit trees such as Bel, Amla, Guava, Falsa, etc. may also be commercially cultivated. Studies have shown the prosperity of this gallantry land with many trees such as *Anogeissus pendula, Butea monosperma,* and *Tectona grandis* which may bring real benefits if grown commercially. They have several health benefits against piles, gastric disorders, wound healing, leukoderma, dysentery, etc. *Aloe vera,* which is commonly known for its rich medicinal properties and significant use in beauty products may be successfully grown in Bundelkhand conditions.

There are several areas in Banda, Mahoba, Lalitpur, and Jhansi near mining sites that are suffering from poor soil health, deposition of heavy metals on the soil surface, lesser vegetation, and respiratory problems among the local population due to extensive mining, therefore, to lessen the distress, fibre and oil yielding plants like cotton, linseed, Indian mustard, etc. can be cultivated near mining sites for phytoextraction of the heavy metals from soil and decreasing their translocation into the food chain. There are many cotton varieties such as Bt Cotton which is developed for the cultivation in limited resources such as low rainfall, less productive soil, etc. Studies have shown better cultivation of Bt Cotton in adverse conditions, resulting in high yield and higher economic benefits to the struggling farmers. Vidarbha region of Maharashtra which has somewhat similar environmental conditions like Bundelkhand has successfully incorporated Bt cotton varieties and is giving tough competition in terms of cotton yield to the states like Punjab, Haryana, Andhra Pradesh, and Telangana which are known for cotton production.

**Conclusion :**

Cash cropping of the above plants may give more benefits than expectancy if grown in a scientifically combined way. The turmeric and aloe vera plants may be grown on outer circle/boundaries as it is not eaten by the cattle, and other medicinal plants may be grown in middle. Likewise, lemongrass be cultivated on wasteland as it does not require much irrigation and is also not liked by stray cattle for grazing. Also, it protects land from soil erosion and has a good market value. However, the industrial development of this region should also be taken care of at the same time. As sufficient mandies should be available with potent buyers for direct purchase of raw materials from the farmers. At present, Bundelkhand region has insufficient industries that too very few among them are related to utilizing agricultural products as raw material for processing. Certainly, for the success of the alternative approach, a strong mandi system where farmers could sell their raw materials/products and earn good money should be developed on priority.

# Role of agro-processing in rural development and employment generation

**Shiv Kumar[1] and Anjali Srivastava[2]**

Rural poverty, employment generation and human resource development are principal goals in the developing economies of India. Removal of unemployment itself cannot eradicate rural poverty. household. Agro-processing is any intervention through which the primary agriculture produce can be turned into any other useful commodity. Proper processing facilities will result in reduced post harvest losses and also efficient use of the by- products. The focus on processing at village level shall result in proper use of farm produce, crop residue, animal power and commercial forestry products.

It is well known that India is Agro rich country. With the production of agriculture activity of $375.61 billion, India is 2nd largest producer of agricultural products. India accounts for 7.39 per cent of total global agricultural output (OECD). The Agriculture sector's contribution to the Indian economy is much higher than the world's average (6.4%). The industry and services sector's contribution is lower than the world's average 30% for the Industry sector and 63% for the services sector. Large labor force of India is engaged in agriculture sector (55% to 60%). Still India is facing poverty and unemployment as major issues after so many technological developments. Measures to eradicate poverty have, therefore, to go beyond employment programmes and should focus on agricultural production and rural development. There is need for agricultural growth to close the supply-demand balances for different agricultural commodities and to generate more rural incomes and purchasing power to sustain a widening rural industrial and service sector. Traditionally the produce of rural areas is being processed in urban areas. The dal mills, rice mill, sugar factories, oil extraction units are located in urban or semi urban areas. The small scale, cottage and tiny industries with low investment in rural areas can transform the agro-processing sector after localizing and identifying the level of production of the commodities at these places.

**Scope for agro-processing in rural areas**

Most important point in the agro-processing is that a sizeable portion of raw material processed in them. Being rural based, it has a very high employment potential with significantly lower investment. Development of these industries would relax wage goods constraints to economic growth by enhancing the supply of their products. Also the establishment of processing industries in rural areas will reduce transportation cost for input supply and relaxation in many more wage goods constraints. There will be availability of multiple raw materials year round. Industries can utilize solar energy for primary processing. In this context there is a need for improving the capacity of the agro-industries to harness backward linkages with agriculture and allied activities in order to efficiently convert part of the output to value added products acceptable to the domestic and international markets. Present share of India in international trade of processed food is only about 1.5%.

**Role in development and employment generation**

There is huge demand for organic, hand processed, sun dried, low energy consuming, and zero preservative food items all over the world. This would generate employment opportunities for different types of skills through food processing, packaging, grading and distribution. At the same time this will transfer a size margin to farmers

[1]*Head, Dept of Food Technology & Dean, Engineering Bundelkhand University, Jhansi (Email : skkatiyar69@gmail.com)*
[2]*Assistant Professor, Department of Food Engg. & Tech., Bundelkhand University, Jhansi(anjali011bt@gmail.com)*

through market linkages. Low cost land for establishment of units and labour will be a great advantage as it will prevent migration of labour force. Also, the labours will be benefitted by various government schemes and subsidies. For example, Government is providing 50% subsidy against post harvest losses to the farmers involved in processing sector.

**Different processing levels of agro-commodities**

Agro-processing has four different levels. In Primary level, removal of impurities, grading as per size, quality, ripening stage etc. Secondary level is further processing of primary produce to reduce volume or making it fit for consumption by roasting, grinding, frying or preserving by sugar, salt or acidic medium like vinegar. Tertiary is converting the secondary processed food into ready to eat items like bread, jam, sauce, namkeen etc.; and final processing level includes advanced treatments like increasing shelf life by advanced technology for export or off season sale.

**Major agro-processing commodities at rural areas**

**Cereals & its products**

The cereals amount to about 40% of total crop production. The shelf life is highest with low cost or technology inputs. The present losses have been estimated to 9-10%. The main issue is construction of scientific storage space. The scientific storage, proper improved packing and transportation facilities can reduce the losses to minimum. Transition storage is equally important such as, at rail head or at collection centers.

Processing of cereals in India is organized and unorganized sectors also. Primary processing involves milling and shelling. Both of these can be shifted to rural areas. Processing of paddy at rural level will be more beneficial, as the additional activity of oil extraction from rice bran can be started. The expected production of oil is about 5-10% by weight. The other cereal based products like Dalia, Maida, Papad, rice products like poha, laiyya etc. can be produced in small scale rural units.

The modernization and upgradation of rice mills and flour mills at rural level will create additional employment. Similarly the bakery units can also be established in rural areas, which may create its own niche market in semi-urban or small towns.

**Fruits & vegetables**

Due to large number of agro-climatic zones and different types of soils, there is huge variety of fruits and vegetables are available round the year. The transportation facilities and improvement in infrastructure sector has resulted in reduced wastage and better returns to the farmers as compared to earlier days. However, the 80% of fruit production comes from 7 varieties alone which are banana, mango, citrus, guava, apple and pineapple. Banana and mango account for 60% of the total production. Productivity is very low as compared to other producing nations, there is scope for increasing the excess will be available for processing or exports.

The total production is about 135 MT. The total spoilage at various levels is estimated at 25-28%. The present share of India in international trade is 1% only. The present level of processing is about 2-4% depending on the type of produce. If we do not substitute the fresh consumption and process only the wastage, the income generation to rural people will be enormous. The processing of these produce can be done in the form of pickles, jam, sauce or syrup etc. The solar assisted drying of vegetables is also possible with simple solar dryers. Except for export, high technology is not involved in the processing of fruits and vegetables.

The simple technological applications can revolutionize this sector at rural level. The proper grading using screens and packing at farm level will reduce the wastage and fetch better price. The pre-cooling facilities will improve the shelf life of the produce. The by-product generated during processing can be fed to livestock or it can be converted into manure.

**MilK & milk products**

The India's milk production is highest in the world. The *operation flood* or *white revolution* resulted in increased milk production along with remunerative price for the farmers. The main contribution of the

operation flood was to convert milk from perishable item to non perishable and transportable item. At present marketing network exists in the entire nation.

The most of the production comes from the small and marginal farmers. The milk yield of cattle in India is very low, to our wonder, it is as low as 1/10 of Denmark. Therefore, there is good scope for increasing the yield and using the surplus for processing and export. The large scale chilling plants and the packing facilities at rural level may not be feasible. There are many options which can be tried at rural level. Some products like khowa and paneer, milk sweets, making ghee and unprocessed butter & buttermilk needs local production platforms.

**Sugar cane**

Traditionally the sugarcane can be processed into various products at village level without any complex technological intervention. Some of the product like Gur (Jaggery) , raw sugar, vinegar and sweets, after mixing with nuts or different seeds can be produced.

**Medicinal plants & herbs**

Lot of herbs and medicinal plants are consumed in dry or dry powder form directly, and does not form part of prescription medicines. The same can be manufactured in rural areas under proper control. Similarly the primary processing of medicinal plants like removing useful part (i.e. leaves/stem/ roots/fruits/seeds) and supplying it to drug manufactures can be taken up by rural people.

**Requirements for rural development & employment generation**

Productivity of Indian farms is lower than the international average. The quality of produce is not uniform. Large number of middle men are present in marketing channel. Transport and storage infrastructure is not adequate in rural areas. The cost of packing in some cases is more than the cost of the produce. Also, lack of knowledge about government schemes, technologies among rural people are major constraints.

Macro level initiatives required to develop agro-processing in rural areas. The consumer awareness about nutrition and food value should be increased. The people of rural areas may be encouraged to take up food processing as part time business initially then move towards up- scaling. The retail chains and corporate buyers should be encouraged to source the products directly from the farmers without involvement of middle men. Private investment in core infrastructure should be encouraged so that the wastage before primary processing or during primary/secondary processing can be controlled. The ancillary sector for production of equipments and tools can be included as priority sector as food processing.

The marketing support like AMUL is required to be developed for the processing sector. The existing network of KVIC/NAFED like institutions can be used for marketing of quality controlled goods in urban areas. Formation of large multi state cooperatives or dedicated sourcing and marketing companies will help in reaching global markets. The organized business houses may adopt some processing sectors and geographical areas to procure primary or secondary level processed items for further processing and export. The testing and certification institutions may be established all over the country as certification is prerequisite for export.

Any type of processing requires skill for quality produce and low wastage. Structured training is required for tertiary and advanced processing. Similarly, training is required in the fields of certification, inspection and quality control. The packaging of finished products is equally important and trained manpower is required. The training programs can be started in ITI, Polytechnics or under various employment generation schemes.

The establishment of food parks and contract farming are some of the steps for popularization of the processing sector. Ministry of Food processing Industries (MoFPI) is providing assistance for workshops/seminars/exhibitions/ publications/films.

Few more facilities for technology up gradation/ modernization; grant assistance for training centre

and entire capital cost of establishment of quality control laboratories to state/central govt. organizations; some policy initiatives such as amendment to APMC Act, declaring it a seasonal industry, lowering of VAT rates etc. are expected from states.

Technological support is required for control of loss due to fungus, pests, rodents etc.; correct harvesting, moisture control and transit storage; control of leakage and mechanical breakage during transport.

There is a huge possibility of getting mutual benefits after establishing agro-processing industries in rural areas at one condition that the networking and management as well as better technological ground should be there. This initiative will not only lead to the profit of the industry but also to the rural development and employment generation and utmost nation economical strengthening. The constraints and remedies are discussed thoroughly here. The right of countries to pursue rural development policies in which agriculture plays a key role must be recognized. The rural areas depend to a large extent on policies to maintain the farming sector. Rural development policies which affect the agricultural sector should follow the principle of being no more than minimally trade-distorting and allow structural changes to occur.

# Food laws for quality control and food safety

**Ghanshyam Abrol and Ranjit Pal**

Food is a major determinant of health, nutritional status and productivity of the population. It is, therefore, essential that the food we consume is wholesome and safe. Unsafe food can lead to a large number of food-borne diseases. You may have seen reports in the newspapers about health problems caused by contaminated or adulterated foods. Globally, foodborne illness is a major problem of public health concern.Consumption of unwholesome food endangers public health. Quality of food stuff, raw as well as processed is of public health concern and must be addressed. In the past decade, safety challenges faced globally as well as in India have changed significantly and issues related to food quality and food safety have gained tremendous importance.

In India some food borne diseases are commonly referred to as food poisoning and are often reported in newspapers. Only a very few of them are reported and when recorded most of them are categorized under 'gastroenteritis'. Food-borne illnesses are often viewed as mild and self-limiting but they may be life threatening too. A few of them may have serious and chronic health implications. They are also important underlying factors leading to malnutrition with serious impact on growth and immune function of infants and children. Adults could suffer from chronic ill health. Even in an organization like the Indian Army with high standards of hygiene, a review of food borne diseases over a 25-year period indicated that there were 128 recorded outbreaks affecting over 5000 persons resulting in 11 deaths. The biological agents responsible for food borne diseases in the Indian context include bacteria, viruses, parasites, fungal and algal toxins, and various naturally occurring toxins (e.g. Lathyrus) adulterants, various chemical agents including pesticide residues. Food-borne illness can not only result in mortality but can damage trade and tourism, lead to loss of earnings, unemployment and litigation and thus can impede economic growth, and therefore food safety and quality have gained worldwide significance.

**Significance of food laws**

Food safety and quality are important at the home level, but are critical in large scale food production and processing, and also where food is freshly prepared and served. In the past, many foods were processed at home. Advancement in technology and processing, larger per capita incomes and better purchasing power as well as increased consumer demand have led to a variety of products of processed foods, food for health / functional foods being manufactured. Safety of such foods needs to be assessed. A number of factors are responsible for this:

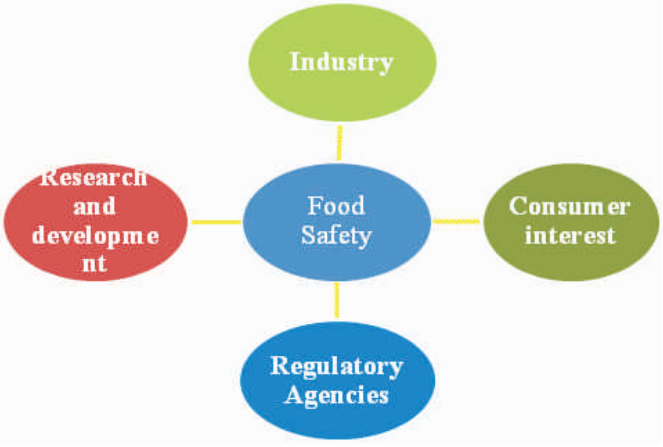



**Fig. 1: Inter-relationship of different components effecting food safety**

- With fast changing lifestyles and eating habits, more people are eating outside their homes. In commercial settings, foods are prepared in bulk handled by many persons, thus there are more chances of food getting contaminated. Further, food items are prepared many hours in advance, and may spoil if not stored appropriately.

*College of Horticulture & Forestry, Rani Lakshmi Bai Central Agriculture University, Jhansi-284003*
*Corresponding Author: ghanshyamabrol@gmail.com*

- There are many processed and packaged foods. Safety of these foods is important.
- Spices and condiments, oilseeds were processed at home in former times and purity of these were not a concern. In today's world, prepackaged individual spices, condiments, spice powders and mixes are in demand, especially in cities and metros. Quality of even raw food stuff besides processed foods is of public health concern and must be addressed.
- Logistics governing transport of bulk food is complex and there is a long gap between processing and consumption. Thus risk assessment and safety management during mass production and mass distribution is critical.
- Microbial adaptations, antibiotic resistance, altered human susceptibility and international traveling have all contributed to increasing incidence of food-borne microbial diseases. Nearly half of all known food-borne pathogens have been discovered during the past 25-30 years. There are still many food borne illnesses of unknown etiology. This is an issue of global public health concern and there is a need to detect, identify and recognise emerging pathogens and establish active surveillance networks, nationally and internationally.
- India is a signatory to the World Trade Organisation (WTO) non-tariff agreement, which has provided greater access to world markets and opportunities to all countries to enter international trade. In this scenario, it has become essential for every country to protect the safety and quality of foods and also ensure that imported foods are of good quality and safe to eat. Effective food standards and control systems are required to protect food production within the country as well as to facilitate trade with other nations. All food manufacturers are required to meet the given standards of quality and safety, and need to have their products regularly tested.
- Pollution in atmosphere, soil and water, including use of pesticides in agriculture, bring their share of contaminants. Also use of additives such as preservatives, colourants, flavouring agents and other substances such as stabilisers makes the analysis of food for various components-both nutrients and contaminants-imperative.
- Owing to the above factors, there is a growing concern for safe, wholesome and nutritious foods in a highly dynamic food business environment, which in turn has greatly expanded the scope and has increased career opportunities in this sector. Before learning about the various career options in this field, it will be worthwhile for us to understand the basic concepts regarding food quality, food safety, risk assessment, food standards and quality management systems.

**Basic Concepts**

Food safety means assurance that food will not cause any harm to the consumers. An understanding of food safety is improved by defining two other concepts - toxicity and hazard.

Toxicity is the capacity of a substance to produce harm or injury of any kind under any conditions. Hazard is the relative probability that harm or injury will result when substance is not used in a prescribed manner and quantity. Hazards can be physical, chemical and biological causing harmful / adverse effects on the health of consumers.

- Physical hazard is any physical material not normally found in food, which causes illness or injury and includes wood, stones, parts of pests, hair etc.
- Chemical hazards are chemicals or deleterious substances which may be intentionally or un-intentionally added to foods. This category of hazards includes pesticides, chemical residues, toxic metals, polychlorinated biphenyls, preservatives, food colours and other additives.
- Biological hazards are living organisms and include microbiological organisms. Those micro-organisms which are associated with food and cause diseases are termed food-borne pathogens. There are two types of food-borne diseases from microbial pathogens—infections and poisoning.

- Food infection /Food Poisoning results from ingestion of live pathogenic organisms which multiply in the body and cause disease. Salmonella is a classic example. This organism exists in the intestinal tract of animals. Raw milk and eggs are also sources. Heat destroys Salmonella, however, inadequate cooking allows some organisms to survive. Often Salmonella is spread through cross-contamination. This could happen when a cook cuts raw meat/poultry on a chopping board and without cleaning uses it for another food which does not involve any cooking, such as salad. Food may become infected by Salmonella if an infected food handler does not wash hands with soap after using bathroom and before touching food. Salmonella can reproduce very quickly and double their number every 20 minutes. The symptoms of Salmonella infection include diarrhea, fever and abdominal cramps.
- Food intoxication: Some bacteria produce harmful toxins which are present in food even if pathogen has been killed. Organisms produce toxins when the food has not been hot enough or cold enough. Toxins in food cannot be detected by smell, appearance or taste. Hence foods which smell and appear good are not necessarily safe. One example of such an organism is Staphylococcus aureus. Such organisms exist in air, dust, water. They are also present in the nasal passage, throat and on skin, hair of 50 per cent of healthy individuals. People who carry this organism, contaminate food if they touch these places on body while food handling. Diarrhea is also one of the symptoms of this contamination. Parasites can also cause infestation, e.g., worm infestation by tape worm in pork. In addition to this, food can be infested by pests and insects.
- Among the various hazards, biological hazards are an important cause of food-borne illnesses. In spite of all the efforts in the area of food safety, microbial food-borne pathogens are still a serious concern and new pathogens continue to emerge.
- Factors that are important in the emergence of pathogens include human host, animal hosts and their interactions with humans, the pathogen itself, and the environment including how food is produced, processed, handled and stored. For example, changes in host susceptibility due to malnutrition, age and other conditions can allow for the emergence of new infections in vulnerable populations. Genetic exchange or mutations in the organisms can create new strains with the potential to cause disease. Exposure to new pathogens through changes in eating habits, climate, mass production, food processing and increased globalisation of the food supply can allow pathogens to emerge in new populations or new geographic areas. Examples are Norovirus, Rotavirus, hepatitis E contributing to about 70 per cent of cases. New pathogens will continue to evolve and there is a need to develop methods to isolate them, control them and detect their presence in foods. In the context of food safety, it is important to understand the terms contamination and adulteration.

**Food Quality**: The term food quality refers to attributes that influence a product's value to consumers. This includes both negative attributes such as spoilage, contamination, adulteration, food safety hazards as well as positive attributes such as colour, flavour, texture. It is therefore a holistic concept integrating factors such as nutritional traits, sensorial properties (colour, texture, shape, appearance, taste, flavour, odour), social considerations, safety. Safety is a preliminary attribute and precursor of quality. In order to ensure that foods are safe and of good quality, across the world various governments and international bodies have laid down food standards that manufacturers/ suppliers are expected to adhere to. Thus, all food service providers (those involved at all stages of pre-preparation and preparation/ processing, packaging and service).

should adhere to good manufacturing practices and ensure food safety. Salient points to be borne in mind are:

1. Quality of raw materials and water
2. Cleanliness – of the premises, personnel, equipment, food preparation and storage and serving areas
3. Storage of food at appropriate temperature
4. Food hygiene
5. Good service practices

**Food Standards**

a. Effective food standards and control systems are required to integrate quality into every aspect of food production and service, to ensure the supply of hygienic, wholesome food as well as to facilitate trade within and between nations. There are four levels of standards which are well coordinated. a. Company Standards: These are prepared by a Company for its own use. Normally, they are copies of National Standards.

b. National Standards: These are issued by the national standards body.

c. Regional Standards: Regional groups with similar geographical, climate, etc. have legislation standardisation bodies.

d. International Standards: The International Organisation for Standardisation (ISO) and Codex Alimentarius Commission (CAC) publish international standards.

**Food Standards Regulations in India**

Food safety and standards act, 2006 -An act to consolidate the laws relating to food and to establish the Food Safety and Standards Authority of India for laying down science based standards for articles of food and to regulate their manufacture, storage, distribution, storage, distribution, sale and import, to ensure availability of safe and wholesome food for human consumption and for matters connected therewith or incidental thereto.FSSA, 2006 bring the different pieces of legislation pertaining to food safety under one umbrella. FSSAI has been established under Food Safety and Standards Act, 2006. Various central Acts like:Prevention of Food Adulteration Act, 1954; Fruit Products Order , 1955; Meat Food Products Order , 1973; Vegetable Oil Products (Control) Order, 1947; Edible Oils Packaging (Regulation)Order 1988; Solvent Extracted Oil, De- Oiled Meal and Edible Flour (Control) Order, 1967; Milk and Milk Products Order, 1992 etc. will be repealed after commencement of FSS Act, 2006.

The Act also aims to establish a single reference point for all matters relating to food safety and standards, by moving from multi- level, multi-departmental control to a single line of command. To this effect, the Act establishes an independent statutory Authority – the Food Safety and Standards Authority of India with head office at Delhi. Food Safety and Standards Authority of India (FSSAI) and the State Food Safety Authorities shall enforce various provisions of the Act.Ministry of Health & Family Welfare, Government of India is the Administrative Ministry for the implementation of FSSAI.

**Functions of FSSAI:**

- Framing of Regulations to lay down the Standards and guidelines in relation to articles of food and specifying appropriate system of enforcing various standards thus notified.
- Laying down mechanisms and guidelines for accreditation of certification bodies engaged in certification of food safety management system for food businesses.
- Laying down procedure and guidelines for accreditation of laboratories and notification of the accredited laboratories.
- To provide scientific advice and technical support to Central Government and State Governments in the matters of framing the policy and rules in areas which have a direct or indirect bearing of food safety and nutrition.
- Collect and collate data regarding food consumption, incidence and prevalence of biological risk, contaminants in food, residues of various, contaminants in foods products, identification of emerging risks and introduction of rapid alert system.
- Creating an information network across the country so that the public, consumers, Panchayats etc receive rapid, reliable and

objective information about food safety and issues of concern.

- Provide training programmes for persons who are involved or intend to get involved in food businesses.
- Contribute to the development of international technical standards for food, sanitary and phyto-sanitary standards.
- Promote general awareness about food safety and food standards.

**Bureau of Indian standards -** Indian National Standards are formulated by National Standards Body - Bureau of Indian Standards (BIS).It is governed by Bureau of Indian Standards Act, 1986 and Rules and Regulations framed there under.BIS has been entrusted the job of formulation of National Standards under an Act of Parliament.Food and Agriculture Department of Bureau of Indian Standards has formulated various standards since inception and has so far developed around 1800 standards in the different areas.

**International Organisations**

Since ancient times, governing authorities the world over, have made attempts to develop and implement food standards in order to protect health of consumers and prevent dishonest practices in sale of food. There have been several international organisations and agreements which have played a role in enhancing food safety, quality and security, facilitating research and trade. The major organisations which are playing a key role are:

1. Codex Alimentarius Commission (CAC)
2. International Organisation for Standardisation (ISO)
3. World Trade Organisation (WTO)

**1. Codex Alimentarius Commission (CAC)**

Codex Alimentarius Commission is an intergovernmental body formed with the objective of establishing international standards to protect the health of the consumers and facilitate food and agricultural trade. In 2017, the membership of Codex was 187 member countries and one Member Organisation (European Community) respectively. India is a member through the Ministry of Health and Family Welfare. CAC has become the single most important international reference point for developments associated with food standards. The document published by the CAC is Codex Alimentarius which means 'Food Code' and is a collection of internationally adopted Food Standards. The document includes Standards, Codes of Practice, Guidelines and other recommendations in order to protect consumers and ensure fair practices in food trade. Different countries use Codex Standards to develop national standards.

**2. International Organisation for Standardisation (ISO)**

The International Organisation for Standardisation is a worldwide, non-governmental federation of national standards bodies (ISO member bodies). The mission of ISO is to promote the development of standardisation and related activities in the world with a view to facilitate the international exchange of goods and services, and to develop cooperation in the spheres of intellectual, scientific, technological and economic activity. The work done by ISO results in international agreements which are published as International Standards. ISO 9000 is an international reference for quality requirements. It is concerned with "Quality Management" of an organisation. Adoption of these standards is voluntary.

**3. World Trade Organisation (WTO)**

World Trade Organisation was established in 1995. The main objective of WTO is to help trade flow smoothly, freely, fairly and predictably, by administering trade agreements, settling trade disputes, assisting countries in trade policy issues. The WTO Agreement covers goods, services and intellectual property. In order to enforce adoption and implementation of standards, there is a need for a strong Food Control System. An effective food control system must consist of — (i) Food Inspection and (ii) Analytical capability. Food Inspection: Conformity of products to standards is verified through inspection. This will ensure that all foods are produced, handled, processed stored and distributed in compliance with regulations and legislation.

Government / Municipal authorities appoint food inspectors to investigate the status of quality conformity to standards in their laboratories. Analytical capability: There is need for well-equipped, state-of-the-art accredited laboratories to carry out analysis of food. Further, well- trained personnel having knowledge of principles of laboratory management and physical, chemical and microbiological analysis of food, test foods and food products are also required. A broad range of analytical capabilities is required for detecting food contaminants, environmental chemicals, biotoxins, pathogenic bacteria, food-borne viruses and parasites. Food Safety Management Systems Over the years, issues related to food safety and quality have gone beyond just the avoidance of food-borne pathogens, chemical toxicants and other hazards. A food hazard can enter/come into the food at any stage of the food chain, therefore, adequate control through out the food chain is essential. Food safety and quality can be ensured through :

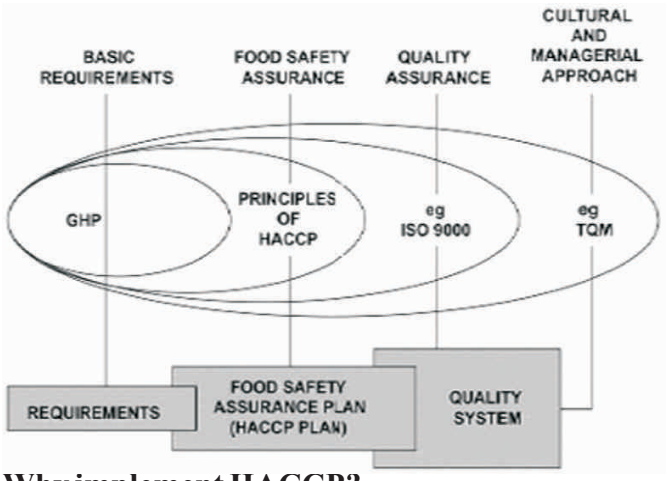
- Good Manufacturing Practices (GMP)
- Good Handling Practices (GHP)
- Hazard Analysis Critical Control Points (HACCP)

Good Manufacturing Practices (GMP) are a part of quality assurance to ensure that manufacturers/ processors take proactive steps to ensure that their products are safe. It enables to minimise or eliminate contamination and false labelling, thereby protecting the consumer from being misled and helping in purchasing products that are not harmful. GMP is a good business tool that helps to refine compliance and performance by the manufacturers/producers.

Good Handling Practices indicate a comprehensive approach from the farm to the store or consumer, in order to identify potential sources of risk and indicates what steps and procedures are taken to minimise the risk of contamination. It ensures that all persons who handle food have good hygiene practices.

**Hazard Analysis Critical Control Point (HACCP)**

HACCP is a means of providing assurance about safety of food. HACCP is an approach to food manufacture and storage in which raw materials and each individual step in a specific process are considered in detail and evaluated for its potential to contribute to the development of pathogenic micro organisms or other food hazards. It involves identification of hazards, assessment of chances of occurrence of hazards during each step /stage in the food chain – raw material procurement, manufacturing, distribution, usage of food products and defining measures for hazard(s) control.




**Why implement HACCP?**

- It is a preventive approach to ensure food safety.
- End product inspection and testing, although important, is time consuming, expensive and detects the problems only after they occur. In contrast, HACCP enables us to detect hazards at any stage of processing or manufacture in order to ensure a good quality end product, by taking appropriate action at the stage where the problem occurs.
- It enables producers, processors, distributors and exporters to utilise resources efficiently and in a cost effective manner for assuring food safety.
- FSSA, 2006 places primary responsibility for safe food with producers and suppliers through HACCP, GMP, GHP. This is important for consumer protection and international food trade.
- It assures consistently good quality products.

# Value addition pipelines machinery and equipment for agri-community

**D. Mohapatra, M.K. Tripathi, S. Deshpande and S.K. Chakraborty**

India is endowed with a wide variant flour and fauna, each geographical area its own ecosystem and traditional food habits. Except for some cereals crops and fruits and vegetable are popularly consumed throughout the country, while many remain unexplored, their usage being limited to a particular area. With globalization and migration of the workforce to different regions, those local products have a better chance of getting integrated in mainline food systems.

Post-harvest, value addition of agricultural materials through mechanization is a way to employment generation, reduce losses. Value-Addition in agricultural commodities refers to the processing done on the various farm commodities to be able to reap the benefits of providing a processed form of the raw commodity at cottage level.

India has become self-sufficient in agricultural production; however, with stagnation of agricultural lands, burgeoning population is exerting tremendous pressure for improving the quantity and quality of production. There is no denying that despite contributing to large chunk of the total GDP, farmers are still fighting for their existence. The economical stand of this community is dwindling in a thin thread, which gets threatened with natural calamities like flood, unseasonal rain, or lack of rain, manmade obstructions, even epidemic. It is heartening to see farmers throwing away their products on the road during the glut season, even rotting of grains due to lack of transportation, storage and processing facilities. On the other hand, rise of price in some essential commodities like onions brings the tears to the eyes of common man and becomes a topic for national debate. It is an irony that despite several fold increase in the food production, still some people are not getting a full meal. Malnutrition is still prevailing in most of the rural and urban areas alike. Price fluctuations, lack of infrastructure, technical knowhow are also impending factors in achieving food security and financial stability. Agricultural mechanization still to reach its full potential, which can improve the productivity, reduce drudgery and boost the economy. Agricultural producers are facing several problems:

1. Lack of multi-commodity storage facilities
2. Lack of commodity specific processing machinery
3. Lack technological knowhow

**Employment generation through value addition to agricultural commodities**

Agricultural commodities can be grouped under durable, perishable and semi-perishable. Mostly food grains like cereals, pulses, oil seeds and nuts are considered to be durable crops, while crops like potato, onion, and sweet potato which can be stored under normal environment for several months are categorised under semi-perishable commodities. Fresh fruits, vegetables and animal products, which have a limited shelf life lasting from few hours to few days, are grouped as perishable commodities.

Processing of agricultural produce can be classified into primary processing, secondary processing and tertiary processing.

**Primary processing:** Primary processing of agricultural produce refers to the minimal processing of produce, so as not to change its original composition and form. During this process, the agricultural raw material is converted into food commodities. Some of the primary processing operations used for food grains and fruits and vegetables are (1) Cleaning, Washing (fruits and vegetables), Grading, Drying, Milling,

*ICAR-Central Institute of Agricultural Engineering, Bhopal-462038 (M.P.) India*

Cutting (fruits and vegetables), Shelling (peanuts, maize), packaging.

**Secondary processing:** This refers to conversion of food materials into edible form, which may change the basic characteristics of the ingredient. Some of the examples are baking extrusion cooking, fermentation, puffing, popping.

ICAR-Central Institute of Agricultural Engineering, Bhopal and has been working tirelessly in developing some of the drudgery reducing machinery for both pre-harvest and post-harvest processing operations, as well as development of several value added products. Several equipment have been developed for the primary and secondary processing of agricultural commodities, especially millets. Besides, several value added products have been developed and by products have been utilized. Some of the technologies are presented in the following sections.

Simple primary processing of some agricultural products can fetch better price for the product and can generate employment opportunities for rural youth and women. A cleaned and graded dal and shelled groundnut fetch a better price in the market than the unprocessed commodities. Government is also encouraging for establishment of food processing centres and agricultural commodity processing centres. Special package have been being given to agripreneurship for processing as well manufacturing of small scale processing equipment to cater cottage level processing industries, in the form of subsidies and easy loans. All these opportunities need to be explored and technical knowhow can be disseminated by the State Agricultural Universities, Central and ICAR Institutes. Custom hiring of agricultural implements for the production has been a success and the same can be replicated for processing equipment, through mobile processing units and establishment of agro-processing centers at different clusters, depending on the local need.

Very simple tools are used for these post-harvest operations, which are nonetheless affordable to start a small entrepreneurship. Some of such affordable technologies developed at CIAE are being mentioned in the following sections.

## CIAE technologies for processing of food grains

### Groundnut decorticator

Ground nut decorticator can be operated both in sitting ad standing position has been developed at ICAR-CIAE, Bhopal and costs around Rs. 2000-3000 (Fig. 1). These equipment are ergonomically designed for both men and women.

**Fig. 1. CIAE Groundnut decorticator**

**Fig. 2. CIAE Maize sheller**

An octagonal Maize Sheller is available and has a very nominal price (Fig. 2). Maize can be shelled with it and can reduce drudgery and improve the productivity. This tool is suitable for both men and women operators and simple to operate and fabricate.

A motorised maize dehusker-sheller has also been developed for higher capacity and for commercial purpose (Fig. 3).


**Fig. 3. Power operated Maize dehusker and sheller**

## Dal milling

CIAE has developed a dal milling process for pigeon pea (Fig 4). CIAE Bhopal has developed a low cost dehusking and splitting dal mill for rural use (5a). The machine consists of an abrasive carborundum roller dehusker and has a capacity of 100 kg/hr. This machine can be owned, operated and manned by less skilled people of rural and semi-urban areas. The mill operates with a 1.5 KW, 3 phase electric motor. The cost of milling was estimated to be Rs. 14.0 per quintal. The average recovery in case of pigeonpea, mungbean and urdbean was claimed to be 75% and 74% each, respectively. As water treatment is recommended with the mill, the use of edible oil in the process of dehusking has been completely eliminated in this process.

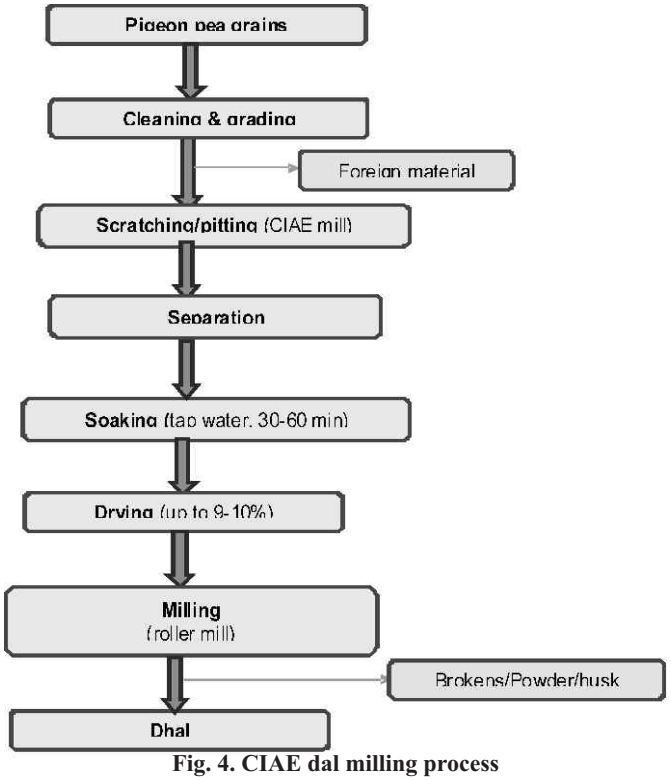



**Fig. 4. CIAE dal milling process**

A modern dal mill (5b) is also established at CIAE which is suitable for redgram and available on custom hiring basis.

## Millet Processing

Millet processing aims at reducing drudgery, efficient recovery of raw materials, development of value added products, maintenance of quality and improvement in shelf life of both raw material and processed products.


**Fig. 5a. Mini Dal mill (b) Modern dal mill at CIAE,**

## Threshing of millets

Owing to their small size millets are required to be threshed from their panicles. A multi-millet thresher has been developed by CIAE, which can thresh millets like kodo, little, foxtail, proso, barnyard and finger millets, with efficiency ranging from 94-97% in 1 or 2 passes (Fig. 6). The capacity for various millets varies between 20-200 kg/h.

**Fig. 6. CIAE millet thresher**

## Primary Processing:

Primary processing steps includes cleaning, grading, and dehusking without changing the physical form of the grains. Since millet grains, especially small millets are very small in size and endowed with hard pericarp, dehusking is an onerous task, which has traditionally been done by manual labour.

## Machinery:

### Cleaner & Grader

Millets are very small in size hence a pedal operated cleaner cum grader has been developed at CIAE to cater to the need of rural/ tribal area, where available electricity is poor (Fig. 7). The equipment has a feeder,which feeds the grains to vibrating screens and an blower. Lighter materials are blown away by the blower, which operates through the pedal operated motor. The screens are designed considering the size and shape of small millets.

Fig. 7. Milletcleaner and grader

**CIAE-Millet mill:**

CIAE millet mill consists of a complementary working frame to accomplish the goal of dehulling (gentle abrasion/ attrition with spring loaded suspension mechanism) and separation of husk simultaneously (pneumatic suction) not allowing the dehulled mass to go outside (Fig. 8). The technology has been commercially adopted and is very successful.

**Secondary processing**

**CIAE- Fermented millet processing line**

CIAE-millet processing line has been designed to produce fermented grains as well as fermented millet fakes. The processing line can process 25 kg of millets per batch and consists of (I) a specially designed fermentor cum steaming vessel, (ii) pneumatic conveyor cum dryer, (III) flaking machine, (IV) flakes conveyor, and (V) Dryer (Fig. 9).

To establish a fermented millets flour or riceproduction unit, grain bins, dehusker, aspirator, destoner, fermentor, dryer, burr mill, weighing machine and packaging machine are required.

**Establishment of agro processing centres**

An agro produce processing centre (APC) can be established with following equipment Grain bins,Cleaners (sieve), Destoner, Aspirator, Dehusker, Grader, Burr mill/ hammer mill/ Flour mill (multi commodity), Flour sifter, Mini rice mill, Mini dal mill, Packaging machine (sealer), Weighing machine. The APC can be customized depending on the regional produce and availability of raw materials (Fig. 10).

Fig. 8. CIAE Millet mill

Fig. 9. Fermented millet flakes production unit

Fig. 10. Millet Processing Center is established at Harshdiwari village, Tamia block of Chhindwara district of M.P.

# Prospect and opportunities of entrepreneurship development in dairy and poultry farming for rural youth

**Sanjit Maiti, Sanchita Garai and Ruchi Yadav**

Animal husbandry along with agriculture continues to be an integral part of human life since the process of civilization started. These activities have contributed not only to the food basket and draught animal power but also by maintaining ecological balance. They further play a significant role in generating gainful employment in the rural sector, particularly among the landless, small and marginal farmers and women and finally being a dependable "bank on hooves" in times of need. Growth of this sector may get accelerated by increasing capacity of the stakeholders, by establishing producer companies as well as start-up companies through different entrepreneurship development programme among the women, youth from both farm and non-farm sector like IT sector. Therefore, as much as animal husbandry sector will grow, the economic well being of the people of the country will grow.

India has vast resource of livestock and poultry, which play a vital role in improving the socio-economic conditions of rural masses. There are about 300 million bovines, 74 million sheep, 149 million goats, about 9 million pigs and 852 million of poultry as per 20$^{th}$Livestock Census in the country. According to estimates of the National Statistical Office (NSO), the Gross Value Added from livestock sector at current prices was about Rs. 963 thousand crore during 2019-20 which is about 28.36 per cent of the Gross Value Added from total agriculture, forestry and fishing sector at current prices. The livestock sector is contributing about 5.88 per cent of total Gross Value added of the Country at current prices .At constant prices (2011-12), the gross value added of livestock sector is about Rs. 577720 core during 2019-20 with a positive growth of 7.00 percent over previous financial year.

Among four important livestock species, cattle represent over 37 per cent of the population followed by buffaloes (21%), goats (29%) and sheep (12%). While cattle and buffaloes are reared for milk and animal power, sheep and goat are maintained mainly for meat, with milk and wool as secondary sources of income. Cattle and buffaloes, which are considered as milch animals, are large in size, partly stall fed and require substantial quantity of feed and fodder for economic management. However, majority of the nutritional requirement in terms of meat and eggs are fulfilled by the poultry.

**Why do we need entrepreneurship development programme in animal husbandry and poultry?**

**High demand of animal source food:** Four, out of the five highest valued global commodities are from livestock i.e. milk, meat, pork and chicken meat. Of late eggs replaced the maize among the top global commodities. The demand for cereals going to increase from 2 billion tons to 3 billion tons, milk from 664 million tons to 1 billion tons and meat from 258 million tons to 460 million tons each year in the year 2050 over the year 2005-07. Rising demand for milk, meat and eggs is a global phenomenon, but demand is greatest in South Asia (includes India also) and Sub-Saharan Africa. Traditional means of dairy and poultry farming cannot meet this mammoth demand. But, new and growing entrepreneurs may fulfil this demand.

**Prevailing of small holder mixed crop-livestock farms:** Livestock and cereal products are produced prominently by small holder mixed crop-livestock farmers and small holders still dominate livestock production in many countries including India. More than 70 million rural families depend on dairy and 25 millions depend on small ruminants for their

*Dairy Extension Division, ICAR-National Dairy Research Institute, Karnal-132001, Haryana*
*Corresponding Author: Sanjit.Maiti@icar.gov.in/sanjit.ndri@gmail.com*

livelihoods and income in India. They produce the bulk of the livestock products and are competitive and continued to be competitive in the future also. Mixed crop-livestock systems of the developing country produce 55% of the cereals, 41% of the milk, 50% of the beef and 72% of sheep and goat meat in the world. The specialty with small holder production system is 90 percent of animal products are produced and consumed in the same region or country most of which produced by the small holders. Small holder shares in milk, eggs, beef, chicken meat and sheep/goat meat in India was 69, 71, 75, 92 and 91 percent, respectively. However, small holder numbers increased from 70 million to 140 million but average land holding is decreased from 2.3 ha to 1.2 ha from the year 1970-71 to 2010-11. So, entrepreneurship development programme may clubbed these small holder producers into several common interest groups, cooperatives, farmers' producer organization etc.

**Employment generation among the rural youth**: Enterprises like dairy, goatry, poultry etc. are labour intensive, and have high potential in employment generation. Thus, they serve as an antidote to the widespread problems of disguised unemployment or under-employment stalking the rural territory especially among the youth. By providing employment, these enterprises also have high potential for income generation in the rural areas. These enterprise, thus, may help in reducing disparities in income between rural and urban areas. Establishment small livestock enterprises may foster economic development in rural areas. On the one hand, this may also curb rural-urban migration, lessens the disproportionate growth in the cities, reduces growth of slums, social tensions, and on the other hand, it reduces atmospheric pollution. The livestock related enterprises can also play a significant role in management of natural resources in a better way, thus environment friendly and lead to development without destruction.

**Points to be taken care to establish a successful commercial dairy enterprise**

i. **Choosing healthy dairy animal:** The first and most important requirement for a successful commercial dairy farm is the selection of good quality healthy dairy animal. The selected dairy animals must be healthy, with good weight and of a proven breed. While purchasing cattle the eyes, nose, udders, mobility, coat and other features must be carefully observed.

ii. **Good housing:** To have good productivity, sufficient space must be provided to the dairy animals. Generally, 40 square feet inside, and 80 square feet outside space is a good enough for a healthy and productive dairy animal. Therefore, a dairy farm with 20 animals must have a minimum area of 3000 square feet. In case of a dairy farm with 100 animals, 13,000 to 15,000 square feet of space is essential for their comfortable accommodation. At the same time, sufficient flow of clean and fresh air and proper ventilation must be ensured.

iii. **Nutritious feeding:** Near about 70 percent cost of the milk production goes to the feeding management of the dairy animals. A normal adult animal must be fed with at least 15-20 kg of green fodder and 6 kg of dry fodder. For pregnant animal, 3 kg of compound cattle feed, 1 kg oil cake, 50 gram of mineral mixture and 30 grams of salt may be given in addition with normal feed. To increase digestibility and reduce wastage, fodder is chaffed and they are fed 3-4 times a day in equal intervals. This rationing is an attempt at reducing wastage and increasing digestibility. A normal healthy adult animal requires 75 to 80 liters of water per day usually. This can increase to 100 liters during summers. They must have regular access to clean drinking water. Crossbred cows and buffaloes are given a bath twice a day during summer to maintain their body temperature.

iv. **Neonatal care:** Provide 2 litres of colostrum (first milk produced) within the first 2 hours of birth and then again 1-2 liters depending on weight of the calf within the next 10 hours. The calves must be de-wormed every month upto 6 months of age once the calf is about 2 weeks old. vaccination must be done at the age of 3 months.

Calf starter may be provided for good growth and early maturity from the 2nd week of birth.

v. **Disease management:** Dairy animal must be vaccinated against the highly fatal diseases like foot and mouth diseases, black quarter, hemorrhagic septicemia etc with help of the qualified veterinarian every six month and yearly. Mastitis is also an important disease of dairy animal and cause of huge economic loss. This disease can be managed with the adoption good hygiene practices in the farm.

**Points to be taken care to establish a profitable poultry farm**

Commercial poultry farming in India has created and still creating profitable business opportunity for the entrepreneurs. Poultry farming in rural area creates a good number of employment generation. Output of this enterprise i.e. egg and meat has a huge demand throughout the year. If a young farmer practices the following points carefully during establishing his/her poultry farm, then, his/her farm must be a profitable one.

i. **Choosing suitable location:** Try to setup the farm in rural areas that is slightly far from the city. The area of the land depends on the number of birds and farming system. Free range farming system requires more land than intensive system. While selecting land, ensure a great source of sufficient amount of fresh and clean water. The selected area must have to be free from all types of harmful animals and predators.

ii. **Farming system and breeds:** There are three systems are followed in India for poultry farming viz. intensive system, semi-intensive system, and extensive system. Selecting high quality productive breeds is very important for successful poultry farming in India. There are numerous local and foreign high quality poultry breeds available in India. Choose proper breeds according to your desired production. If you want to start producing eggs commercially, select highly productive layer poultry breeds. The poultry breeds that is suitable for commercial meat production is known as broiler poultry. They are like meat producing machines. They consume foods and convert them to meat quickly. They grow fast and become suitable for slaughter purpose within very short time.

iii. **Proper housing and cage:** Make a proper ventilation system in the house. Because, good ventilation system ensures good health and proper growth of the birds. So, the house must have to be well ventilated. If you go for large scale commercial production and make numerous house, then the distance from one house to another house will be at least 40 feet. Housing also varied based on the type poultry birds are being rearers in the farm.

iv. **Feeding management:** Feeding good quality and nutritious food keeps the poultry birds healthy and productive. So, good and high quality nutritious food is a must for commercial poultry production. There are numerous poultry feed producing companies available in India. They produce feeds for all types of poultry birds. You can easily use those foods for your birds. Homemade poultry feed can be prepared, but, during preparation at home, expert guidance is utmost necessary.

v. **Care and management:** Standard protocols consists of day to day schedule including vaccination are available to maintain a commercial poultry farm. The farmers must follow these protocol to make his/her poultry farm a profitable one.

**Dairy Entrepreneurship Development Scheme**

The department of Animal Husbandry and dairying is implementing Dairy Entrepreneurship Development Scheme (DEDS) for generating self-employment opportunities in the dairy sector, covering activities such as enhancement of milk production, procurement, preservation, transportation, processing and marketing of milk by providing back ended capital subsidy for bankable projects. The scheme is being implemented by National Bank for Agriculture and Rural Development (NABARD).

**Target group/beneficiaries**

i. Farmers, individual entrepreneurs and groups of unorganized and organized sector. Group of organized sector, includes self-help groups, dairy cooperative societies, Milk unions, milk federation, Panchayati Raj institutions, etc.

ii. An applicant will be eligible to avail assistance for all components under the scheme but only once for each component.

iii. More than one member of a family can be assisted under the scheme provided they set up separate units with separate infrastructure at different locations. The distance between the boundaries of two such farms should be at least 500 m.

iv. Priority to be given to project being implemented in cluster mode covering dairy farmers/women in SHGs/Cooperatives/Producer companies

v. Priority to be given to SC/ST/women/landless/ small and marginal/BPL farmers and also farmers in drought areas.

**Components under this scheme**

i. Establishment of small dairy units with crossbred cows/ indigenous descript mulch cows like Sahiwar, Red Sindhi, Gir, Rathietc /graded buffaloes upto 10 animals. (for SHGs, Cooperatives societies, Producer Companies unit size will be 2-10 animals per member).

ii. Rearing of heifer calves — cross bred, indigenous descript milch breeds of cattle and of graded buffaloes — upto 20 calves.

iii. Vermi compost with milch animal unit (to be considered with milch animals/small dairy farm and not separately.

iv. Purchase of milking machines/milkotesters/ bulk milk cooling units (upto 5000 lit capacity).

v. Purchase of dairy processing equipment-for manufacture of indigenous milk products.

vi. Establishment of dairy product transportation facilities and cold chain.

vii. Cold storage facilities for milk and milk products.

viii. Establishment of private veterinary clinics.

ix. Dairy marketing outlet / Dairy parlour.

For the details of scheme, plz visit to https://www.nabard.org/auth/writereaddata/tender/2705194754Cri_135_E.pdf

# Entrepreneurship development in silage for enriched animal diet

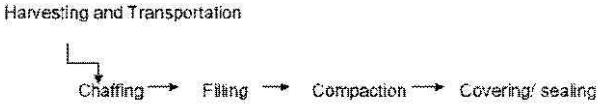
**P.K. Pathak[1], P.N. Dwivedi[2], Amit Kumar Patil[3], C.S. Sahay[4] and S.K. Singh[5]**

Silage is green fodder persevered in the form of fermented product for animal feed. It is produced under anaerobic condition by action of organic acid (lactic acid) as preservative. It is used during lean period and is an economical product for feeding livestock. It is practiced in intensive animal production systems to acts as complementary feed to grass for productive animals in temperate region and meet the quality fodder need during winter. However, due to high capital investments, labour intensive cumbersome processes and drudgery involved, the silage was not popular in past but due to mechanization and ease of handling the silage as an animal feed product is gaining popularity in coming decades.

Silage is useful when production of green fodder is high in one season and there exists acute shortage in another i.e. summer. It could also be useful, in tropics where major feed resources are crop residue/ low grade forages. It has many advantages such as lower field losses particularly of leafy portion which is relatively rich in protein and minerals; lower probability of rain damage and thus leaching of nutrients; storage over longer period under optimal ensiling conditions; provide more succulent feed to livestock; less dependence over weather conditions etc.

Suitable fodder crops for ensiling are maize, sorghum, millets, oats, perennial forages etc. For production of silage, maize and sorghum are harvested at 50% flowering to dough stage whereas oats are harvested boot to dough stage, grasses can be harvested at early flowering stage (2-3 cuts can be taken depending upon growth) and BN Hybrid and Guinea grass are harvested at about 1.5m height. Following process steps could be followed to achieve good quality silage:

**Process steps:** All the ensiling process as below should be completed in 3 – 5 days




**(i) Harvesting/chaffing and transportation:** Many machines available to harvest green fodder stem and keep aside such as cutter bar type harvesters as well as to harvest and chaff together to upload in a trolley such as flail mower or chopper cum loader. These machines can be selected depending upon raw material, volume of work and money. If green fodder stem are harvested manually or by cutter bar type harvesters, power operated or manual chaff cutters can be selected for chopping. Chaffing favors the growth of lactic acid bacteria and improves packing.

**(ii) Filling, compaction and covering:** It helps in rapid evacuation/ exclusion of air from the silo thus checks the aerobic respiration and nutrient loss. It also improves the density of fodder due to uniform size and provides proper anaerobic condition. Chopped fodder is filled in silos and compacted either manually or other means like treading by tractors so as to remove air from bulk and covered properly. When the bags are filled it may be compacted manually or mechanically and bags are stitched. Care should be taken that the chopped material is filled into the silo, layer by layer in a short span of time (1-2 days) and the crop is compacted by continuous treading to remove the inside air. The heap is then sealed quickly by covering it with polythene sheets. The cover should be such that it prohibits the movement of air in to and from the heap and also does not allow the sun

*[1]Principal Scientist (Agriculture Structures & Process Engineering) and Head, [2]Principal Scientist (Animal Nutrition), [3]Scientist (Farm Machinery and Power), [4]Principal Scientist (Farm Machinery and Power), [5]Principal Scientist (Agriculture Structures & Process Engineering), Farm Machinery and Post Harvest Technology Division, ICAR – Indian Grassland and Fodder Research Institute, Jhansi (UP) - 284 003 India*

light to pass from it. This improves the heating of silo by its own temperature and speeds up the fermentation process. Temperature should be in the range of 15 to 25° C to allow growth of lactic acid producing species of bacteria and inhibiting the undesirable clostridial species. In any case, silage temperatures should not exceed 30°C over a prolonged time period, which may drastically reduce true digestibility of fresh forage protein from 90 per cent to 30 per cent or less.

**(iii) Period of ensiling:** Silage is ready in 45-60 days after covering

**(iv) Moisture content during ensiling:** 65-70% (Dry Matter: 30 - 35%)

**(v) Thumb rule to observe moisture:** Have a palm full chopped material and press it in palm to form a ball. Open the palm:

- If the ball suddenly opens, moisture connect is too low (>30-40%)
- If this ball remains it shape, moisture content is too high (80-85%)
- If this ball opens slowly, moisture content in fodder is suitable to be ensiled (65-70%)

**(vi) Size of silo:**

- Properly compacted chaffed material weighed 350 kg per cubic meter in a silo.
- For one animal @ 10 kg silage/day would have silo of 1 $m^3$ (1x1x1 m).
- For one animal @ 20 kg silage/day would have a silo of 2 $m^3$ (2x1x1 m).

**(vii) Physical appearance of silage:**

- Brown and greenish brown in colour
- It should be fragile not clumpy
- It should have pleasant aroma of lactic acid

**(i) Use of additives**

| Chemical parameters | Silage quality | | |
|---|---|---|---|
| | Good | Intermediate | Poor |
| pH 4.2- 4.8 | 4.8-5.2 | Above 5.2 | |
| Lactic acid % | 3-14 | variable | variable |
| Butyric acid % | Under 0.2 | 0.2 - 0.5 | Over 0.5 |
| Proportion of total acids % | | | |
| Lactic | Over 60 | 40 - 60 | Under 40 |
| Acetic | Under 25 | 25 - 40 | Over 40 |
| Butyric | Under 5 | 5 - 10 | Over 10 |
| Ammonia N(% of total N) | Under 10 | 10 - 16 | Over 16 |
| ADIN (% of total N) | Under 15 | 15 - 30 | Over 30 |

**(i) Use of additives**

- Commercial bacterial inoculants can also be used to increase the rate of lactic acid fermentation.
- Molasses can be added @ 5-10% depending upon the sugar content of ensiling forage.
- Whey, yeast and other energy rich ingredients, have also been used as additives to increase the fermentation and feeding value of silage.
- Addition of urea @ 0.5-1.0% has been found to increase CP content.

**Important aspects in silage making and its removal for feeding**

- Utmost care to be taken in making and removing the silage as well from silo pits:
- The material to be conserved must have a high nutritive value.
- The forage must not be contaminated with soil.
- Expel the maximum amount of air within the forage before closing the silo, or sealing the bag/containers.

- All the operations from harvesting to sealing the silage in containers should be done in the shortest possible time.
- The best strategy is to make silage at different times of the year and supply it for feeding purpose after approximately 60 to 70 days of conservation.
- During feeding of the silage, minimum area should be exposed to air to avoid the spoilage.
- Covers should be kept firmly in place as long as possible.
- Top layer which came into contact with air should be discarded.

**Feeding silage:**

- At first instance animals may not like its taste. Provide 2 to 5 kg of silage in their ration for the first 5 to 6 days to develop the test.
- After developing the test to the animal, 10 to 20 kg per head per day silage may be fed along with other fodders. It is especially suited to milch cow for producing more milk.

**Strategy for developing Entrepreneurship in silage and its marketing**

Machinery use is preferred in view of labour shortage. Making silage needs crop to be harvested and chopped so that it can be filled in silos. Looking into the process steps involved, at first for harvesting the crop from the fields many machineries are available commercially which can harvest the whole crops and chop the crop and loaded simultaneously into the accompanying trolleys. The capacity of these machines should be decided on the basis of silage to be produced. Silos may be pits or bags or and structure which can provide air tight situation after filling. Many innovative ideas can be generated for making silage for marketing needs. It includes use of bags/barrels for ease of handling. Such barrel/bag should be designed in such a way that it could be sufficient for feeding one or two animals daily. For successful marketing it should be appropriate in weight to handle and feeding livestock per day. Stock should be stored and maintained for at least two months so that after proper fermentation it can be ready to feed the livestock directly after approximately 60 to 70 days of conservation. There should be different compartments/selves/rows for storage of barrels/packets indicating day wise tagging to packaging space so that the fermented products should be identified easily and proper material can be marketed. A lag period of about 7 days may be taken for handling of products including their transport/dumping into the market, while designing storage space at site. Proper strategy should be planned for per day sale/feeding as per consumption and distance of travel by the market requirement through market survey. There is no such compulsion for silage in barrel or in bags to store them at factory site. These silage in barrels/bags could be sold even on day one with proper instruction not to open before 60 days so that proper fermentation occurred. They can be transported to far distant areas, can be stored at distributer site or at a godown in different city for a period as long as possible until and unless the storage condition in the container is not disturbed. For marketing the silage various e-platforms including e-NAM, Kisan Rath and other sites should be explored and preferred.

**Marketing**

- Barrels should be washed in a strong detergent solution using a brush and rinsing in hot water.
- Air-dry silage containers.
- Doorstep delivery, particularly for high-risk groups is possible when packed in barrels.
- Have opportunity to store several months' feed ration at once and also could be the preferred mode to supply to the stakeholder in view of physical distancing perspective.

A system for vacuum bagging the chopped forage material to produce quality silage and make the process easy for carrying the bags of 30-50kgis possible and can be explored. This system can provide opportunity for bagging the chopped maize corn, tapioca pulpand wet spent grains from breweries in 30kg bags and may have utility for production of designer feeds including total mixed ration for livestock.

# Agriculture and entrepreneurship: New initiatives and early experiences

**Hulas Pathak**

Myriad efforts have been made by the Central and State governments to boost agriculture and allied sectors, more so in the past few years. In addition, there's effort made by a number of the foundations and not-for-profit enterprises to support technologies which positively impact small holder farmers. The sector possesses renewed thrust due to various measures on credit, market reforms and food processing under the Atma Nirbhar Bharat announcements. Despite the legacy challenges that Indian agriculture has been burdened with for many years, a show of record-high productivity is happening. Less mechanization, limited sources for farmers education and awareness, insufficient storage, postharvest inadequacies and logistical challenges, and really small landholdings are the factors that contribute to hamper growth of Indian agriculture industry. The industry's efficiency is additionally exceedingly low, because it employs nearly 60% of India's population while contributing only 18% of the country's GDP

The world's population is predicted to grow to almost 10 billion by 2050, boosting agricultural demand – during a scenario of modest economic process – by some 50 percent compared to 2013. Agricultural production quite tripled between 1960 and 2015, owing partially to productivity-enhancing revolution technologies and a big expansion within the use of land, water and other natural resources for agricultural purposes. The same period saw an interesting process of industrialization and globalization resulted due to green revolution into the food and agriculture. Food supply chains have lengthened dramatically because the physical distance from farm to plate has increased; the consumption of processed, packaged and ready to eat foods has increased altogether except the backward rural communities.

However, the decline within the share of agriculture in total production and employment is happening at different speeds and poses different challenges across regions. Although agricultural investments and technological innovations are boosting productivity, the growth of yields has slowed to rates that are too low for comfort. Food losses and waste claims to be a big proportion of agricultural output and reducing them would lessen the necessity for production increases.

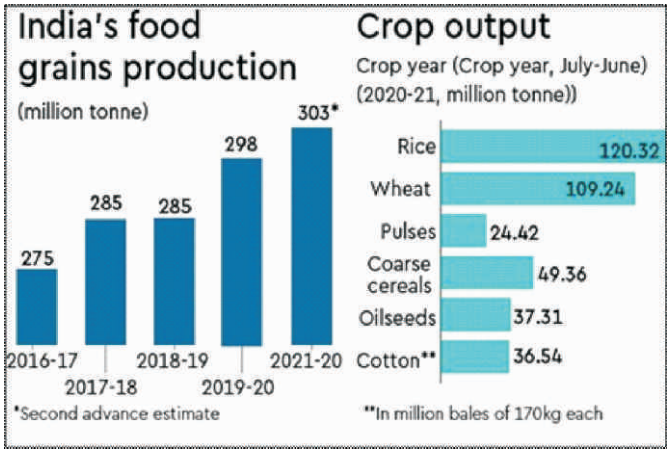
**Agricultural growth in India**

The resilience of India's agriculture sector is often seen from the very fact that despite the ongoing COVID-19 pandemic, its performance in output was strong. About 54.6% of the entire workforce within the country remains engaged in agricultural and allied sector activities (Census 2011) which accounts for about 17.8% of the country's Gross Value Added (GVA) for the year 2019-20, while the difficulties created by COVID-19 induced lockdowns adversely affected the performance of the non-agricultural sectors, the agriculture sector came up with a strong rate of growth of 3.4% at constant prices during 2020-21. In the year 2019-20, total grain production within the country is estimated at record 296.65 million tonnes which is higher by 11.44 million tonnes than the assembly of grain of 285.21 million tonnes achieved during 2018- 19. Further, the production during 2019-20 is higher by 26.87 million tonnes than the previous five years' (2014-15 to 2018-19) average production of 269.78 million tonnes.

Despite the legacy challenges that Indian agriculture has been burdened with for many years, a show of record-high productivity is happening. Less mechanization, limited sources for farmers education and awareness, insufficient storage,

*Head & PI -CEO, IGKV R-ABI, Indira Gandhi Krishi Vishvidyalaya, Raipur Chhattisgarh*
*E-mail: hulaspathak@rediffmail.com*

postharvest inadequacies and logistical challenges, and really small landholdings are the factors that contribute to hamper growth of Indian agriculture industry. The industry's efficiency is additionally exceedingly low, because it employs nearly 60% of India's population while contributing only 18% of the country's GDP




**Source: Financial Express News**

According to the second advance estimates, released by the Ministry of Agriculture, the entire food grains output is estimated to increase by nearly 2% from the previous year and also exceeded the official target of 301 MT, while rice production is seen at 120.32 MT, up by 1.2% and wheat output is estimated at 109.24 MT, up by 1.3%. Another major factor that affects the growth of the agriculture sector in India is the choice of the crops. There is a massive over production of grains like wheat and rice, which create very low value in comparison to high-value vegetables crops, fisheries, poultry and dairy.

## Government Initiatives on Strengthening Agriculture

There have been myriad efforts by the central government and state governments to boost agriculture and allied sectors, more so in the past few years. In addition, there's effort made by a number of the foundations and not-for-profit enterprises to support technologies which positively impact small holder farmers. The sector possesses renewed thrust due to various measures on credit, market reforms and food processing under the **Atma Nirbhar Bharat** announcements. Various interventions of the govt. in farming, dairying and fisheries is aimed at tapping the potential of allied sectors to further enhance farm welfare. In addition to varied measures aimed toward enhancing productivity and improving marketing of agricultural produce, the govt also carries out a huge food management programme with a big financial implication in terms of food subsidy. Under the Pradhan Mantri Garib Kalyan Anna Yojana, 80.96 crores beneficiaries were provided additional foodgrains, i.e. above the NFSA mandated requirements, of 5 kg per person per month freed from cost till November, 2020, amounting to a fiscal outgo of over Rs.75000 crores.

Through implementing these initiatives, the central government is attempting to fulfil the government's key agrarian agenda of doubling farmers' income by 2022. To accomplish this agenda, government also promoting **'Startup Agri India'**, apart from organising hackathons to facilitate innovation in agriculture and allied sectors.

## Schemes Promoting Agripreneurship and Allied Sectors

To achieve the agrarian agenda of doubling farmers' income by 2022 , the Central government also announced a Rs. 1 lakh crore **Agriculture Infrastructure Fund (AIF)** for creation of farm-gate infrastructure for farmers. The scheme provides for medium to future debt financing facility for investment in viable projects for post-harvest management infrastructure and community farming assets. Under the scheme, Rs. 1 lakh crore is going to be provided by banks and financial institutions as loans to primary agricultural credit societies (PACS), marketing cooperative societies, farmer producers organizations (FPOs), self-help groups (SHG), farmers, joint liability groups (JLG), multipurpose cooperative societies, agri-entrepreneurs, startups and central/ state agency or local body sponsored public private partnership project, etc.

As a neighborhood of the Atma Nirbhar Bharat Abhiyan stimulus package, a Rs. 15000 crores **Animal Husbandry Infrastructure Development Fund (AHIDF)** has been created. The AHIDF will incentivize investments by individual entrepreneurs, private companies including MSME, farmers producers organizations (FPOs) and Section 8 companies to determine dairy processing and value

addition infrastructure, meat processing and value addition infrastructure, and animal feed plant. Realizing the potential, scope and importance of the fisheries sector, new flagship scheme **Pradhan Mantri Matsya Sampada Yojana (PMMSY)** was launched in May 2020 as a neighborhood of Atma Nirbhar Bharat Package by Government of India with an estimated investment of Rs. 20,050 crores comprising of central share of Rs. 9407 crores, state share of Rs. 4880 crores and beneficiaries' contribution of Rs. 5763 crores for a period of 5 years from FY 2020-21 to FY 2024-25. Under the Atma Nirbhar Bharat Abhiyan, Ministry of Food Processing Industries (MoFPI) has launched a replacement Centrally Sponsored Scheme, **Prime Minister-Formalisation of Micro Food Processing Enterprises (PM-FME)** with a complete outlay of Rs.10,000 crores over the period of 2020- 2025. The scheme is predicted to profit 2 lakh micro food processing units through credit linked subsidy.

**Agritech Startup Boosting Agriculture & Allied Sectors**

In addition to the plethora of govt. initiatives to promote farming and agribusiness, a growing set of agri-entrepreneurs is functioning towards improving farmer access to markets, quality inputs, institutional credit, and insurance through innovation. Indian agritech start-ups try to unravel multi-dimensional problems prevalent in Indian agriculture including low productivity, sub-optimal efficiency within the supply chain, and lack of access to markets, institutional credit, crop insurance, quality inputs and market linkages.

According to reports, there are an estimated over 600 post POC (Proof-of-Concept) agritech startups within the agricultural sector, most of them with a vintage of but five years. Investors also are showing interest towards the agriculture startup ecosystem and have pumped in on the brink of $1 billion in upstream agritech deals over last decade and there's a robust traction with over $600 million invested within the last 2 years. Possibly agritech will still attract capital within the range of $500 million to $ 1billion on annual basis within the coming future alongside the venture capital and angel investors. There are several incubators including agriculture, supported by various departments of Central government that have originated and implemented throughout the country to market entrepreneurship at grass root level and scouting regional talents to require up entrepreneurship as a full-time profession while strengthening and promoting agri innovation at regional level.

**Entrepreneurship Development Schemes**

All over the globe, incubators are receiving attention for developing new enterprises within the fields of technology, service, business ideas etc. in research institutions and universities. The Govt of India has also attempted to rejuvenate the technology and business development ecosystem in various sectors through a number of programmes. To specifically cater to the necessity and modalities for agribusiness promotion, a revamped "Rashtriya Krishi Vikas Yojana - Remunerative Approaches for Agriculture and Allied Sector Rejuvenation" (RKVY-RAFTAAR) has been launched in 2017-18 with a component for innovation and agripreneurship. Through this initiative, a thrust would tend to market agripreneurship and startups. The Rashtriya Krishi Vikas Yojna (RKVY) is a vital scheme of the Govt of India, Ministry of Agriculture and Farmers' Welfare (MoA&FW), aimed toward strengthening infrastructure in agriculture and allied sector so as to market agripreneurship and agribusiness by providing support and nurturing the incubation ecosystem. RKVY-RAFTAAR supports agribusiness incubation by tapping innovations and technologies for venture creation in agriculture. During this process, incubation facilities and expertise already available with participating academic, technical, management and R&D institutions within the country shall be utilized on a personal or collective basis to harness synergies. The prevailing institutional agribusiness incubators would be strengthened on a requirement basis by providing grants-in-aid.

Strengthening of existing agribusiness incubators for integrated rejuvenation and development and fixing new ones (RKVY-RAFTAAR Agribusiness Incubators R-ABIs). There are currently 29 R-ABIs

(RKVY-RAFTAAR Agribusiness Incubators) operational within the country under the RKVY-RAFTAAR Scheme. The R-ABIs are acting as facilitation platforms for aggregation and networking of varied stakeholders including innovators, agripreneurs, investors, mentors and other institutions/bodies and support startup incubates to avail pre-seed and seed stage funding through agripreneurship orientation and acceleration programs

**Early Experiences from IGKV R-ABI, Raipur**

IGKV R-ABI, Raipur is an agri-innovation hub and agri-business incubation centre of Indira Gandhi Krishi Vishwavidyalaya, Raipur Chhattisgarh India. Operationalized as a project, it is supported by the Department of Agriculture, Cooperation & Farmers Welfare (DAC & FW) Govt. of India under the revamped scheme Rashtriya Krishi Vikas Yojana – Remunerative Approaches for Agriculture and Allied Sector Rejuvenation (RKVY-RAFTAAR). The project has been launched in 2018-19 and sanctioned to Indira Gandhi Krishi Vishwavidyalaya, Raipur on 7th March 2019. The centre aims at strengthening infrastructure to promote agripreneurship and agribusiness by providing financial support and nurturing the incubation ecosystem by tapping innovations and technologies for venture creation in agriculture and allied activities.

IGKV R-ABI, Raipur offers incubation space, technical and business mentoring, networking with agribusiness industry, scientific and information resources, conducive and supportive environment for agri start-ups and opportunities for availing government grants-in-aid through its two flagship programme –ABHINAV ( pre-seed) and UDBHAV (seed-stage) as per the guidelines of the RKVY-RAFTAAR Scheme.

Farm machinery, IT & ICT in agri, IOT & AI in agri, sustainable agriculture, supply chain management, agri waste to wealth, fisheries/ aquaculture, animal husbandry, organic farming, agri-biotechnology, soil health are some of the focus areas for promoting agri-innovation.

IGKV R-ABI, Raipur has evolved to become the first and only agribusiness incubator of Chhattisgarh state with continued support from MoA, GoI, RKVY, Government of Chhattisgarh state and knowledge partner Pusa Krishi, IARI, New Delhi, In a short period of little over two years of its operation, IGKV R-ABI, Raipur has successfully incubated 94 agri-startups under its both flagship programs i.e. Abhinav (pre-seed stage orientation program) and Udbhav (seed-stage incubation program) with 44 positive recommendations for grant-in-aid support of Rs 3.83 crores, generated 22+ IPs, 54 DPIIT Registrations, 4 GeM registrations, and 22+ awards through its start-ups. IGKV R-ABI, Raipur ranks first amongst all R-ABIs in securing the highest funding support (INR 50 Lakhs) and highest number of start-ups (12) earning positive recommendation for grant-in-aid support under the pre-seed stage incubation program- ABHINAV 1.0; first amongst all SAU R-ABIs in terms of highest no. of start-ups (24) recommended for fund support, individually for both the incubation programs- ABHINAV & UDBHAV and highest total fund support (INR 2.26 Cr.) in the year 2019-2020.

**Way Forward**

There is a requirement for a paradigm shift in how we view agriculture from a rural livelihood sector to global commercial enterprise. In this context, both cultivation and post-harvest management in agriculture needs urgent reforms to enable sustainable and consistent growth. Measures ought to be taken to extend the productivity of the allied sectors alongside sufficient provision for marketing of the agricultural products.

Food processing and value addition is another such area where entrepreneurship development can play an extremely important role. Another area of emphasis is to strengthen agriculture extension services as they supply technical information to the farmers about improved agricultural practices, guidance on the utilization of farm inputs and other services in support of agricultural production.

**Acknowledgment:-** All data and information sources are gratefully acknowledged

# Impact of schemes on youth empowerment for making self reliant India

**V. David Chella Baskar and Amit Tomar**

Our youth possess great potential and power, and India puts great faith in their capabilities to make India a global leader.It has one of the fastest-growing economies in the world, and its youth make up a fifth of the global population. The world's population has nearly half of its people under 25 years old.In terms of population size, over one-sixth of the world's population is comprised of youth, but they rarely get the recognition they deserve for the role they will play in shaping the future. Youth are involved in nation building activities and their personalities are developed by the program.As a segment of the population, the youth is the most diverse and dynamic.In the future, India is expected to have one of the most favorable demographic profiles in the world, as it is one of the youngest nations in the world.Approximately 27.5% of India's population is between the ages of 15 and 29.

There are a number of schemes run by the Department of Youth Affairs aimed at developing and empowering young people. An overhaul of the schemes was completed in 2014 in order to improve their effectiveness. A budget outlay of Rs.1160 crore will be required to continue the scheme from 2017-18 to 2019-2020.

**Beneficiaries:** Accordance with the National Youth Policy, 2014, youth in the age group of 15-29 years make up the beneficiaries of the Scheme.Specifically for program components geared toward adolescents, the age group is 10-19 years.

**Scheme Components:**

The following schemes and programs have been absorbed into the Rashtriya Yuva Sashaktikaran Karyakram (RYSK):

- National Youth Corps (NYC).
- National Programme for Youth and Adolescent Development (NPYAD).
- International Cooperation (IC).
- Youth Hostels (YH).
- Assistance to Scouting and Guiding Organizations
- National Discipline Scheme (NDS)
- National Young Leaders Programme (NYLP).

**Nehru Yuva Kendra Sangathan (NYKS):** It is one of the world's largest youth organizations, founded in 1972. NYKS has its existence across 623 Districts through Nehru YuvaKendras. In order to engage the youth in nation-building activities, the aim is to develop their personalities and leadership qualities.In accordance with the Societies Registration Act, 1860, NYKS is an autonomous organisation within the Department.In each District, there is a Youth Coordinator (DYC) responsible for the Nehru Yuva Kendra, and in each Block, there are two National Youth Corps (NYC) volunteers working on the programs.

**Programmers/ Activities of NYKS broadly fall in the following categories:**

**Core Programmers:** Programs include Youth Club Development Programs, Youth Leadership Training, Theme-Based Awareness and Education Programmes, Promotion of Sports, Skill Up-grading Programs, Festivals for Youth, District Youth Convention and Yuva Kriti, and Awards for Outstanding Youth Clubs, among others..

**Programmers organized with funding from NPY AD:** These include National Integration Camps(NICs),Youth Leadership and Personality Development Programmes(YLPDPs), Life Skill Training Programmes and Adventure Camps.

*Rani Lakshmi Bai Central Agricultural University, Jhansi-284003, U.P., India*

**Programmers organized with funding from other Ministries/ Organisations :** These include Tribal Youth Exchange Programmes, Adolescent Health and Development Project (AHDP), Projects on Awareness and Education for Prevention of Drug Abuse and Alcoholism in Punjab, etc.

**Programmers in coordination with various Departments/ Agencies :** YKS does not receive any funding, but organises/ participates in various programmes in coordination with various Development Departments/ Agencies. Youth clubs/ MahilaMandals are actively involved in carrying out activities by the District NYKs and the NYC volunteers, working closely with the Development Department / Agencies.Blood donation, planting saplings, the formation of self-help groups, and organizing health/eye/immunization camps are some examples of such activities.

**National Youth Corps (NYC) Scheme:**

In this scheme, youth aged 18-25 years are recruited as volunteers to serve in nation-building activities for a maximum of two years. NYC volunteers must have completed Class X and are paid Rs.2,500/- per month as honoraria. A selection committee, led by the District Collector/Deputy Commissioner of the concerned district, selects NYC volunteers. During the first year of their service, volunteers receive 15 days of Induction Training and 7 days of Refresher Training. NYKS provides skill development training to volunteers after they have served for two years with YKS so that they may obtain employment afterward.

**National Programme for Youth and Adolescent Development (NPYAD):**

Governments and not-for-profit organizations can apply for funding to facilitate youth and adolescent activities through this program. The assistance under NPYAD can be availed under 5 major components, namely,

- Youth Leadership and Personality Development Training,
- Promotion of National Integration (National Integration Camps, Inter-State Youth Exchange Programmes, Youth Festivals, etc.),
- Promotion of Adventure; Tenzing Norgay National Adventure Awards,
- Development and Empowerment of Adolescents (Life Skills Education, Counselling, Career Guidance, etc.),
- Technical and Resource Development (Research and Studies on Youth issues, Documentation, Seminars/ Workshops).

**International Cooperation:** In collaboration with other countries and international organizations/ institutions, the Department works to create an international perspective among youth. In addition to working with UN Agencies like United Nations Volunteers (UNY)/United Nations Development Programme (UNDP) and Commonwealth Youth Programme (CYP) in various youth-related projects.

**Youth Hostels:** Young people are able to experience the country's rich cultural heritage by staying at youth hostels, which promote youth travel. Jointly, the National and State Governments have constructed the Youth Hostels. State governments provide free of charge fully developed land with access to water and electricity and approach roads together with the construction costs of the central government. Managers are appointed by the government to oversee Youth Hostels. Every hostel has a Hostel Management Committee (HMC) that oversees all management-related matters to ensure the hostel runs smoothly. State Government functionaries head the HMC (the District Collector, the DC for the districts, the Youth Secretary, and the State Sports Secretary).

**Assistance to Scouting and Guiding Organizations:** As part of its mission to promote the Scouts and Guides movement in the country, the Department provides assistance to Scouting and Guiding Organizations. This is an international movement aimed at building character among young boys and girls through idealism, patriotism and service to country. Boys and girls who participate in scouting and guiding are also encouraged to develop a balanced mental and physical development. Scouting and guiding organizations are provided with financial support for a number of their programs

including the organization of training camps, skills development programs, holding of jamborees, etc. Among the programs are those related to adult literacy, conservation of the environment, community service, health awareness, and prevention of diseases. There are currently two organizations that are receiving assistance for various scouting and guiding activities. These are (i) Bharat Scouts and Guides and (ii) Hindustan Scouts and Guides.

**National Discipline Scheme (NDS):** When the services of NDS (National Discipline Scheme) instructors were transferred to the States, the Central Government committed to reimburse the liabilities incurred in their pay and allowances. For the settlement of these liabilities, Rs. 2 crores is being provided in the budget (under non-Plan).The company still owes more than 200 crores in outstanding liabilities.

**National Young Leaders Programme (NYLP):** This scheme was introduced during 2014-15. Youth Leadership Scheme is designed to promote leadership skills among the youth so that they may attain their full potential and contribute to nation-building during the process. A key goal of the Program is to motivate the youth to strive for excellence in their respective fields and position them as leaders in their field. It seeks to harness the tremendous energy of the youth for national development.

**National Young Leaders Awards (NYLA):** In every field, young people are doing pioneering work. By recognizing and rewarding outstanding work done by youth, the programme aims to motivate them to strive for excellence in their respective fields. In about 50 identified domains/ sectors, 2 awards will be conferred (one male, one female).

**National Youth Advisory Council (NYAC):** As part of the implementation of the Youth Advisory Council, young leaders and other stakeholders will be actively involved in decision-making processes related to youth issues. The Youth Advisory Council advises Ministries/Departments on youth-related initiatives/issues.In the governance process, the Council will ensure that young leaders from all States and UTs are effectively represented.

**National Youth Development Fund (NYDF):** NYDF aims at mobilizing non-budgetary resources for youth development, which will enable the Department of Youth to supplement ongoing programmes as well as take on innovative initiatives to develop young leaders. NYDF has finalized its operational guidelines and notified all members and taken steps accordingly.

Taking part in our nation's development is crucial for the youth. There is no difference between them and their global counterparts when it comes to innovation and success. In addition to encouraging young people to excel, the government must facilitate their aspirations. The attitude behind any youth developmental activity lies in the three areas of discipline, knowledge and self-sufficiency in terms of utility. The success towards the generation of ideas and fusion of knowledge are certainly flooded in the juvenile minds of young India. Initiation of many startup programmes envisaged for ignited minds. For the development of an economy in both rural and urban areas need to be given much importance for a sustainable way. With the empowerment of the youth force, rural areas can make dramatic improvements in areas like infrastructure, credit availability, literacy, poverty eradication, etc. Every stage of rural youth's development needs to be suited to their tuning. There are already plans in place for rural development, but they need to be reevaluated and properly updated. Accordingly, the government should take action to help rural India. By properly channeling young human capital in their respective fields, they will ultimately achieve bumper harvests. As New India becomes a reality, the dream of being an independent nation will become reality.

# Recommendations of brainstorming workshop on "Entrepreneurship development for post-harvest use of Bundelkhand specific biological resources : Introduction and background"

**Anil Kumar**
Director Education

Brainstorming workshop on 'Entrepreneurship development for post-harvest use of Bundelkhand specific biological resources' was organized by Jhansi District Administration, Bundelkhand Chamber of Commerce and Industries and Rani Lakshmi Bai Central Agricultural University, Jhansi as a knowledge partner. Presently India is the most prosperous country in the world in terms of youth power. This young India should also become self-reliant, for the same purpose, our Hon'ble Prime Minister Shri Narendra Modi announced an ambitious scheme to make the self-reliant India. Among the efforts announced under self-reliant India, many schemes are related to agricultural entrepreneurship, which are basically inspired by the basic mantra of farming as novel profession as compared to other jobs, which is also contemporary in today's perspective. The land of Bundelkhand is famous for its social and cultural diversity as well as agricultural diversity. In the past, local agro-based industries couldn't be developed in this area, but at present this area is progressing in all dimensions and now there are possibilities of doing all kinds of farming.

Traditional farming which was limited to pulses and oilseeds is now moving towards commercial farming. Even new horticultural crops like strawberry, dragon fruit, sandalwood, colored capsicum etc. Due to lack of agro-based industries, we were not able to exploit the agricultural produce from this region,though it is very suitable for agricultural diversification despite the contrasting geographical and socio-economic conditions and the hardworking farmers. In today's environment, the goal of doubling the income in the agriculture sector is not possible without value addition and processing. Along with innovative technology, value addition to agricultural produce and the goal of obtaining economic benefits from agricultural products is the key to success. Therefore, our emphasis should not be limited to primary production but to promote secondary and tertiary agriculture. The farmer grows a lot but what, how and why to grow it is still in a narrow range. For example, coarse grains like millets were once grown in traditional farming on large scale, but people got dispersed due to low production and low market price, but today it has become a VIP agricultural commodity from the point of view of health, due to health benefits and then its products have been sold in various forms. Many medicinal and aromatic plants can be cultivated here. Baidyanath Pharmacy, Jhansi is a leading and old unit of Ayurvedic pharmacy in the country which used to run completely on the raw material from Bundelkhand region but now the situation has changed. Today, new changes are taking place in the agriculture sector and processing, packaging and marketing has become a tool which help in bettering the prospects of any crop or enterprise.

In order to get rid of these problems and backwardness of Bundelkhand, in 2014, the Parliament approved the establishment of Rani Lakshmi Bai Central Agricultural University on August 29, 2020, Hon'ble Prime Minister Shri Narendra Modi ji dedicated this university to the nation. The university is committed to achieve its goals from the very beginning and is engaged in realizing the vision of prosperous Bundelkhand with the prosperity of farmers and is working for the upliftment of farmers along with consumers and promotion of startups related to agro industries. . Under this, the university is going to set up 'Rani Lakshmi Innovation and Incubation Centre'. In which not only the students of the university but also the youth, villagers and other entrepreneurs will be taught the tricks of setting up their self-employment and enterprises. Employment opportunities will be created mainly in agriculture and other sectors like seed production, mushroom production, food processing, agricultural production, agri inputs (bio-fertilizers, bio-control etc.). Research and development programs are also being run for agricultural and food products under the brand name 'Shri

Lakshmi', so that students learn to earn their income under the 'Earn while You Learn' program, by undertaking training through experiential learning.

Along with this, they will be able to contribute in building the nation by playing the role of job creator rather than being a job seeker. For this reason, the 'Agri Innovation' platform was established by the experienced professors and officials of the university, which would help the students to inculcate innovative ideas. Similarly, the youth from rural, urban and semi-urban areas as well as new entrepreneurs will also be helped in setting up the enterprise with their innovative thinking and ideas by Rani Lakshmi Bai Central Agricultural University. During the Corona period, when the country is going through a socio-economic and mental crisis, at the same time, Prime Minister Shri Narendra Modi put forward the concept of self-reliant India, which led new series of development where the acceptance of medicinal and related crops along with agricultural and nutritious products, which are useful in the war against malnutrition and also as a source of healthy food. For this, there is a great need for high quality research and development programs, so that consumers can get tasty, healthy and nutritious agricultural and food products at reasonable prices. Such value-added nutraceuticals, pharmaceuticals, cosmeceuticals, functional foods, smart foods and other health products are in great demand among the general public. And during the Corona period, the consumption of such value-added products, which are collectively called Nutri-Ayur products, is large among consumers, so the university is also promoting research and development programs of Nutri-Ayur products in this area. In view of the immense potential in this field, there is an urgent need to encourage the production and research of food processing and nutri-ayur products by the state and central government through the university in Bundelkhand.

Today most of the small scale industries are based on agriculture and many new products are being introduced in the market every day. Now even agri-start ups are developing based on input and output. Agriculture has now become a sign of entrepreneurship and many big companies have also entered the market of agricultural products. Today in agricultural diversification, apart from domestic varieties, exotic varieties are also being adopted. According to the market, new agricultural crops are being sponsored by the farmers. Agriculture has now become a sign of entrepreneurship. During the workshop, diversified agricultural enterprises have put up an exhibition to showcase their products and demonstrate agriculture's feasibility and prosperity. Even 10 per cent of the crop yield produced in Bundelkhand is not processed and value-added. You can imagine that if we develop entrepreneurship in this sector even 20-25 percent, and then imagine how many businesses and jobs can be generated through these new enterprises. Self-employment is the primary key of agriculture, which can open immense doors for the students of agriculture, horticulture, dairy and forestry.

There is a need to develop agriculture according to globalization and not be limited to the farm and make it employable and profitable through sustainable management method. Till now all the policies have been emphasizing on production but now the time has turned on diversification of use beyond production. We also have to think about export oriented, quality standard products from domestic market keeping global competition. Today quality is the main parameter in food items, which is also the USP and branding of the product. Therefore, one should also take care of crop selection, processing and market price before production. Setting up industries based on product diversification in traditional agriculture as well as many by-products are being made in pulses and oilseeds and there are new possibilities while using these. Innovative thinking is needed at every level so that we can create a start-up by presenting new dimensions in the agriculture sector. There is a need of another revolution in Bundelkhand which should give new dimension to this land by forwarding it towards agricultural entrepreneurship. The specific agricultural commodities produced here be it peas, ginger, coarse cereals, chironji, sesame, lentils all have a special taste and as well as the products made from them will also be different. Vegetables and fruits can also benefit the farmers by giving good price after processing. Figs, pomegranates, citrus fruits, wild fruits, as well as beets, tomatoes, and new varieties can be grown in protected cultivars and thus off-season vegetables can offer good

prices. We have to think that now we have to do something new and do it from this part of the country. Marketing is no longer a problem in today's era because in the era of digital and information revolution one can buy and sell products from anywhere while making handsome profit.

There is a lot of potential in Bundelkhand for the renewal of agriculture based start-ups or cottage industries which were established earlier. Here income and livelihood of tribal people can be strengthened by processing and value addition of many products from forest based produce. More land can be used for agriculture by increasing water conservation and irrigation facilities in Bundelkhand. In this brainstorming workshop, how small, medium and cottage industries can be set up based on agriculture produce is being introduced by imminent experts of many subjects to the students, farmers and new entrepreneurs, in which new, healthy and nutritious products can be made from fruits, flowers, grains, medicines, plants and forest produce. Prospects and market outlook etc. were also told. New entrepreneurs and students listened carefully to the talks of the workshop and discussed ways to generate employment. Government schemes and experts are also available for the agricultural entrepreneurship, so agricultural graduates should be enriched with technical knowledge and set up their agriculture based undertakings and become job creator and not job seekers. Everyone is there to help you just need to take the initiative and you have to do that. There will be hesitation in the beginning, there will be fear of risk. But if the spirit is high, then the destination is achieved.

**Recommendations: Technical Session-I (Potential for technological development in agricultural processing)**

In the first technical session of the two-day workshop, Program Coordinator Dr. Anil Kumar, Director Education delivered the welcome address. President of the first session Dr. Ajit Ram Sharma and Dr. A.K. Pandey apprised about the outline of the session. The technical report of the program was presented by Dr. Manmohan Dobriyal and Dr. Prashant Jambhulkar. The following discussions were presented in this session.

**Detail of fragrance based industries in Bundelkhand (First speaker : Shri Shakti Vinay Shukla, Director, Fragrance and Flavour Development Centre, Kannauj)** showed a short film on the production process of perfumed perfumes and other products and also presented some success stories. He said that Bundelkhand has immense potential for production of oil of lemon grass and poppy grass. He also apprised the farmers about the cost involved for setting up the smallest unit. He also assured to extend full cooperation for this work.

**Expansion of agro/food based processing industry in Bundelkhand: Emerging Trends and Opportunities in Food Processing Sector (Second speaker : Dr. P.P. Gothwal, Principal Scientist, Central Food Technological Research Institute, Lucknow)** informed that Bundelkhand has immense potential for oilseeds and milk processing. For this, he proposed to give all possible training to the farmers and students at his institute. Along with this, he told that his institute also provides training and technical knowledge on processing of fruits and vegetables.

**Processing of fruits and vegetables: An important dimension in Bundelkhand region (Third speaker : Ram Asare, Principal Scientist, Indian Agricultural Research Institute, New Delhi)** He informed about the advanced methods of processing of Amla and Bael along with other fruits as well as processing and value by forming groups, called to increase the production of horticulture crops by promoting them.

**Business opportunities for medicinal and aromatic plants in Bundelkhand (Fourth speaker : Dr. Sanjay Kumar, Principal Scientist, Central Institute of Medicinal & Aromatic Plants, Lucknow)** He said that there is a huge potential for the cultivation of Ashwagandha in Bundelkhand. Told the success story of his organization (Aroma Mission) and gave information about the production technology and processing of Vetivar, Palmarosa, Lemon Grass, Geranium, Kalmegh, Shatavar, and Tulsi under this mission. Also told that after processing, good vermi compost can also be made from available crop residue.

**Importance of protein-rich pulses in processing and value addition (Fifth speaker : Dr. D.N. Yadav, Principal Scientist, Central Institute of Post-harvest Engineering and Technology, Ludhiana)** provided information on processing and value addition of protein-rich pulses. He told that PKV pulse mills are suitable for making and processing pulses, after processing Khesari pulses. Made aware of the method of making it suitable for eating by reducing the toxic element. Also informed about preparing protein powder from pulses.

**Agro processing: An emerging sector for employment generation**

At the end of the session, Dr. Ajit Ram Sharma and Dr. AK Pandey expressed their views. There is a lot of potential for agriculture based industries in Bundelkhand. For which information was given by the scientists of various institutions who came today. Which will motivate the farmers and new entrepreneurs here to produce according to the market. The session ended with vote of thanks.

**Recommendations : Technical Session-II (Opportunities and challenges in enterprise and entrepreneurship establishment)**

The technical session II of the two-day workshop was held under the chairmanship of Dr. Sati Sankar Singh, Dr. Sushil Kumar Chaturvedi and Dr. Vijay Yadav in the afternoon session on February 28, 2021. Dr. Gaurav Sharma and Dr. Vishnu Kumar filed the report of this session. The following presentations were made in this session-

**Millets processing and value addition: Status, scope and challenges (First speaker : Dr. Manoj Kumar Tripathi, Head Scientist, CIAE, Bhopal):** Dr. Tripathi gave a presentation on quality, low cost and environmental tolerance of millet crops, along with this he also shared information about the machines and products developed in millet crops. Dr. Tripathi gave a presentation on farmers of Bundelkhand. He said that there are immense possibilities of millet crops in this area and farmers can create a new history by adding value to them in the group.

**Entrepreneurial opportunities in livestock sector specific to Bundelkhand (Second speaker : Dr. AK Singh, Principal Scientist, NDRI Karnal)** Dr. Singh described the characteristics of indigenous breeds of Bundelkhand and gave information about various milk products. Said that NDRI Karnal provides training to the farmers in this area and the farmers of Bundelkhand can establish their own enterprise in the field of milk production by giving examples of some innovative enterprises started with the help of NDRI Karnal. Can increase income.

**Value added pipeline machinery and equipments of agri community (Third speaker : Dr. Mohapatra, Principal Scientist, CIAE, Bhopal)** Dr. Mohapatra informed about the many equipments and plants developed for millet crops. He shared the success story of the farmers' group of Harshdiwari village of Chhindwara. Dr. Mohapatra emphasized that farmers can use post-harvest techniques (like cleaning, washing, grading, precooling) of their produce to earn more profit, especially in the field of horticulture.

**Agriculture processing, employment generation and rural development scope (Fourth speaker : Mr. Shailesh Gupta, CEO 3SR)** Mr. Shailesh Gupta told that human being can be a good entrepreneur with the coordination of heart, mind and body. Gave examples of new entrepreneurs and said that the farmers of Bundelkhand can start a new beginning with a little risk taking and easy strategy.

**Entrepreneurship and start-ups: Stages in growth (Fifth speaker : Prof. Sanjay Bhayana, NIFTEM, Sonepat)** Dr. Bhayana emphasized on branding of products and said that India has a leading position among start ups in the world. That farmers are supported by many organizations like NABARD, MSME, BIRAK, DST etc. for their entrepreneurship development.

**Challenges of agri exports in agro industries (Sixth speaker : Dr. C.B. Singh, AGM APEDA)** Dr. Singh shared the information about various export products like Mangoes, Chillies and Vegetables etc. made by

APEDA Varanasi and told that in this way opportunities are also present in Bundelkhand. He said that in Bundelkhand this work can be done easily through FPOs to increase the income of the farmers.

At the end of the session, Dr. Sati Shankar Singh, Dr. Sushil Kumar Chaturvedi and Dr. Vijay Yadav expressed their views and recommended new experiments for entrepreneurship and its development in Bundelkhand, creation of FPO groups and target oriented work is required. In this sequence, there is a need to form new FPOs and work on quality improvement and value addition, milk production, horticulture, forestry processing.

The session ended with vote of thanks.

**Recommendations :**

Rani Lakshmi Bai Central Agricultural University played a meaningful role in the brainstorming workshop organized for the first time in Bundelkhand and efforts were made to create awareness among unemployed urban & rural youth and entrepreneurs to increase entrepreneurship in this area. The program has been held under the guidance of Hon'ble Vice Chancellor Prof. Arvind Kumar and coordinated by Director Education Prof. Anil Kumar, the following recommendations have been given after consultation with various experts, deans and directors.

1. For enterprise and entrepreneurship development in Bundelkhand region, Bundelkhand Chambers of Commerce and Industries and Rani Lakshmi Bai Central Agricultural University, technical and knowledge partner, to prepare a database of candidates interested in setting up enterprise, in desired field, their innovative ideas and entrepreneurship, to be developed then its information should be available in one format.
2. Meeting of the officers of the Industries Department and other departments of the District Administration, it is necessary to hold a half-yearly meeting to encourage the entrepreneurs, to inform about the various schemes and various stages of entrepreneurship development.
3. A committee should be formed by the district administration to conduct a baseline survey about the various biological resources and produce of agriculture, horticulture and forestry rich in nutritional and health benefits of Bundelkhand.
4. Administration should run time bound program for branding of Bundeli food items and products. Therefore, there is a need to organize an annual festival at the district level to make the district administration, technical experts, new entrepreneurs, farmers and rural youth aware of the specific products of Bundelkhand.
5. There is a need for branding and promotion of one agricultural product from all the districts of Bundelkhand.
6. In collaboration with the district administration, Rani Lakshmi Bai Central Agricultural University should organize a workshop on technical knowledge and value-added agricultural products of various agricultural industries at an interval of about 1-2 months, in which the participation of those interested in that entrepreneurship development be ensured. About 25 to 50 candidates interested in each field should participate in these workshops.
7. Rani Lakshmi Bai Central Agricultural University will make available the presentations of the lectures presented in the Brainstorming Workshop held on February 28, 2021, to the participants. Simultaneously, articles in Hindi and English by subject experts of the brainstorming workshops will be available through the periodical magazines published by the University, Krishi Jeevan and Agri-Life.
8. Rani Lakshmi Bai Central Agricultural University to submit a detailed project for financial assistance

to the Government of Uttar Pradesh/NABARD for setting up an Innovation and Incubation Center in its premises.

"When tillage begins, other arts follow. The farmers, therefore, are the founders of human civilization."

*- Daniel Webste*

*****

A fertile soil alone does not carry agriculture to perfection.

*- Elias Hasket Derby*

*****

Agriculture is at the core of the state.

*- Dave Cook*

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Agriculture is the process of turning eco-systems into people.

*- Toby Hemenwayr*

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