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Opportunities for Entrepreneurship in Waste Management: Need for Collaborative Approach under NEP

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Review Article

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ABSTRACT

Due to the high demand for food and meat for the world's growing population, the agricultural sector is expanding every year. It is estimated India generates around 500 Mt of crop residue annually. Timely and effective treatment is of utmost importance to utilize organic matter in agricultural waste and avoid environmental pollution. This not only reduces the environmental effects but provides entrepreneurships opportunities to the students. The New Education Policy (NEP) emprises on skilling and entrepreneurships developments Agriculture waste management can be one of the area for skilling to covert waste into wealth. This review of the developments in this area revealed that agriculture waste can be utilised for mushroom cultivation, pig farming vermicomposting and many more. Indian council of Agriculture Research(ICAR) initiations have developed waste management technologies that includes bio char from agricultural waste material, soil less planting media using sugar industry residue, foliar spray from fish waste etc .There is need to establish collaboration for joint research, compilation of the technology to reach large number of stake holders. There is need to design one year course under degree programme that enable students to

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specialise and get diploma or certificate to become entrepreneur. The paper discusses opportunities for collaboration and strategies for effective implementation of Agriculture waste management through entrepreneurship development

Keywords: Agriculture waste; entrepreneurship; institution linkage; waste management.

1. INTRODUCTION

"Global warming is an alarming issue, and to control this condition the best way is to reuse resources. After 1947, agro-waste contains waste which is produced from agricultural products, agro-industries, animal feed, horticulture, aquaculture, etc" [1,2]. "Throughout the world, approximately 140 billion metric tons of biomass is produced from agriculture every year" [3,2,4,5]. However, there is an urgent need to reduce and reuse the agro-waste in proper and systemic manner like bio-composting, mushroom production, energy production, animal. Agriculture has a major share in the overall economy of India. With increase in food production crop residues alsoincreasing. Agro-wastes are the leftovers after harvesting of crops, and it includes leaves, stem, etc. These wastes are large in size and low in protein and fat contents. Examples of waste-generating crops are wheat, paddy, sugarcane, mustard, bagasse, vegetable waste, tea, jute fiber, food products, wooden mill waste, groundnut shell, coconut husk, cotton stalk, etc. It is estimated that India generates around 500 Mt of crop residue annually:(NPMCR) National Policy for Management of Crop Residues (2019**).** Worldwide cumulative generation potential of agricultural residues reveal that China generates maximum residues (716 Mt), followed by U.S.A. (682 Mt) whereas India stands at third position with 605 Mt (Fig. 1). Among India highest residue is regenerated in the state of Uttar Pradesh (109.2 Mt) followed by Maharashtra (52.7 Mt) whereas Karnataka stands at 4th position with 37.6 Mt (Fig. 2). Cereals, fibers, oilseeds, pulses and sugarcane contributed the highest crop residue with production estimations of 352 Mt, 66 Mt, 29 Mt, 13 Mt and 12 Mt, respectively. Among cereal crops- rice, wheat, maize and millets together contributed 70% of crop residue followed by fiber crops (13%). One-acre land produces 2.5-3.0 metric ton paddy straw and the burning of this one acre of paddy straw can destroy 32 kg Urea, 5.5 kg Di-Ammonium Phosphate (DAP) and 51 kg Potash manure which is already present in residues. Primary reason behind managing agricultural waste is to make good sense both environmentally and economically. Systematic utilization of agricultural waste also helps to improve environmental conditions by reducing pollution caused by disposal of huge agricultural waste.

Entrepreneurship opportunities like**,** mushroom cultivation, pig farming, vermicompost and many more are possible from the agriculture waste.

ICAR-initiations on waste management includes bio char from agricultural waste material, soil less planting media using sugar industry residue, foliar spray from fish waste etc. In the same way a many institutions have developed products from banana and other food wastes, biogas wastes etc [6-8]. Central food technological research institute (CFTRI), Indian Institute of Science (IISc) and many engineering institutes are

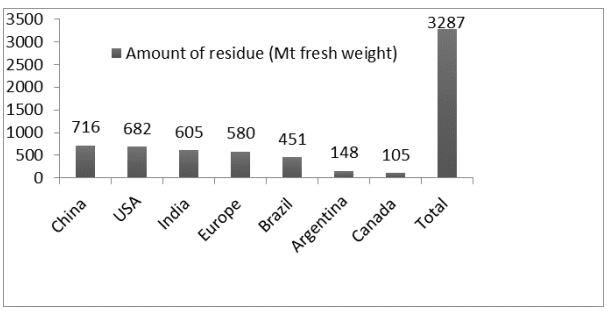

Fig. 1. Cumulative generation potential of agricultural residues in selected countries (Tripathi et al.2019)

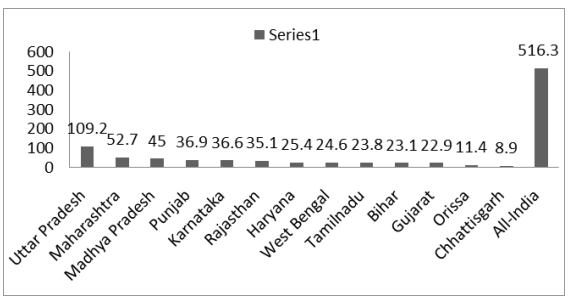

Fig. 2. Top residue generation states in India (SOURCE: Ministry of New and Renewable Energy (MNRE) 2018)

working in these areas. National Education Policy (NEP) gives thirst on entrepreneurship development and skilling. There is need to establish collaboration mechanism to integrate the knowledge and skill and channelize for entrepreneurship development among students. There is need for coordination committee at state level to pool knowledge and skills developed at different institutions. The modules for entrepreneurship development can be developed and introduced in all farm universities. As the national education policy 2021gives opportunity for multiple entry in the degree programmes, there is ample scope for introducing short courses on agri entrepreneurship at university level.

2. METHODOLOGY

Following studies were reviewed and established the similarity and measure recommendations that are relevant to Indian situation. The opportunities for inclusion of agriculture waste management as major subject for skilling and entrepreneurship development are discussed.

Rautaray et al. [9] in their study reported that 24 t agri wastes produced within the farm area yielded 8.1 t vermicompost in three batches. The agriwaste recycling method under organic nutrition increased carbon store in soil by 0.66 Mg ha1 year1 over the four-year experimental period. The carbon stock increased by 0.53 Mg ha1 year1 in the inorganic fertiliser plot. a reduction Among the findings were a drop in bulk density from 1.56 to 1.46 Mg m3, an increase in water holding capacity from 0.43 to 0.52 cm3 cm3, and an increase in accessible P and K content in soil from 38.0 and 174.7 kg ha1 to 45.8 and 186.5 kg ha1 respectively. As a result, recycling agricultural waste on a farm can help improve soil health and crop productivity.

Singh et al. [5] reported that “the highest net returns per metric tonne of dung were obtained from vermicomposting (INR 2224.72, USD 29.42), followed by biogas production (INR 536.66, USD 7.10) and composting (INR 45.59, USD 0.60). Net returns from the dung obtained from one cattle equivalent were highest from vermicomposting (INR 11012.34, USD 145.64), followed by biogas production (INR 2656.74, USD 35.14) and composting (INR 225.68, USD 2.98)”.

Ugwuoke et.al. [10] described “the impact of agricultural waste on sustainable environment and health of rural women. The findings of the study indicated that animal faeces, urine, used litter, beddings, animal carcass, dairy parlor washings, waste milk, wasted feed, feedlot run-off, paunch waste, abattoir waste water, animal viscera, horns, feather, bones, blood, fur, placenta, birth tissues, fetal membranes, aborted fetus among others are the materials that constitute agricultural waste. It was also found that that air pollution from burning of agricultural wastes, air pollution from cesspools, dioxins from burning agricultural wastes, dirty environment from heaps of agricultural wastes, stench/odour from decaying agricultural waste, defacing of the environment, eutrophication of water bodies, aquatic life destruction, spontaneous abortion, blue-baby syndrome, prolonged mensuration and early menopause, among others are the environmental and health impact of agricultural waste on rural women”.

Oladipo et al. [11] studied that “Farm waste utilization among farmers in Irepodun local government area, Kwara State, Nigeria: Implication for extension education service delivery. Results revealed that more than half (58.4%) of the respondents were crop farmers who grow majorly maize and cassava on a subsistence scale. The major farm wastes generated in the area were maize cobs, husk and stalk (62.5%) and cassava stalk and peels (60%). Majority of the farmers got rid of their farm waste through burning while more than half of the respondents do not utilize the waste they generate from their farms. The major constraints militating against farm waste utilization includes inadequate access to extension services, inadequate awareness of benefits of farm waste, inadequate facilities for processing of farm wastes to other products and low knowledge on usage of farm waste. Logistic regression modelling results revealed that farmers who are more likely to utilize their farm waste efficiently are those with higher level of education and more years of experience in farming”.

Minooei and Mokshapathy [9] indicated that Karnataka state Yearly biomass production in Belgum, Golbarga, Tomkur, Raichur,Bijapur & Bellari districts with the maximum production are 8.8, 7.3, 6.2, 5.8, 5.8, 5.4 percent respectively. Important crops in terms of production of agro-residues biomass by respectively share of 30. 2, 20. 2, 13.2, 11.7, 9.5, 7.4, 4.8, 4.1, 1 percentage belonged to the rice, jowar, cotton, corn, peanut, ragi, sugarcane, bajra and wheat.

Aeslina et al. [12] Investigated the viability of using coffee waste in the construction of bricks in 2016. The cw (coffee waste) ratio was a study measure, and temperature. Properties such as density reduction and The compressive strength was taken into account. According to this strategy, three various percentages of coffee waste and a control brick The bricks (CWB) (1%), 3%, and 5%) were produced and burned at 1050°C. Apart from fundamental characteristics such as physical, The shrinkage, density, and compressive strength of the material were all measured. Additionally mentioned the leaching of heavy metals from the toxicity of a produced clay brick was investigated. Technique for leaching qualities It was pointed out that the CW has been added. Despite the fact that the shrinkage rose linearly, comply with a minimum criterion of less than 8% and high quality A lot of brick was made. As a result, there is coffee. Waste can be a problem. used in the manufacture of fire clay bricks with cw in a different proportion It also provides alternatives.

Appaiah et al. [13] investigated the potential of producing bioalcohol from wheat bran agricultural waste. The formation of alcohol from pentose sugar, which is the single ingredient of wheat bran, has been observed. Physical treatments, such as wheat bran particle size reduction, as well as chemical and enzymatic treatments, were investigated for the synthesis of bio-alcohol. Wheat bran with smaller particles was treated with moist heat at 800°C, followed by acid treatment, to create total sugar in the fermentable range. Size of wheat bran, thermal pretreatment, acid pretreatment, and total sugar estimation were the study's parameters.

Sindhu [14] result “pertaining to awareness indicated that awareness about the utilization of biogas plant waste, mushroom waste, wheat waste, mustard and horticultural waste was more than 70 percent. Awareness about utilization of paddy waste, sugarcane waste, cotton waste, floricultural wastes, poultry waste and livestock waste was between 50 to 60 percent. Thus, overall awareness about utilization of agricultural waste was very high”.

Ghorade et al. [15] investigated evaluated the potential of organic farming and sustainable agricultural waste. Such as banana peels in the year 2015 which has become a severe problem due to its output. It has the potential to be developed into a commercial product and can be used to make organic fertiliser. Effective bacteria and molasses ferment the organic waste from banana peels. This is a Fermented Organic Liquid that can be used. This liquid has been used by the municipality as a deodorizer and cleaning liquid. This organic liquid can also be utilised as an organic liquid fertiliser that has been fermented. It works through recycling farm-produced livestock manure, composting, and crop residue management, among other methods.

M. Nidzam et al. [16] investigated the use of agricultural waste in landfill soil stabilisation in 2014. Palm oil ash and rice husk ash were used as the principal constituents of the material as a sustainable alternative to standard Portland cement. POFA (Palm Oil Fuel Ash) or RHA, either alone or in conjunction with Lime or Portland Cement, were used to stabilise landfill soil on its own and in combination with laterite clay soil (PC). As controls, standard stabilisers such as lime or Portland Cement (PC) were used. When compared to the other stabiliser and soil combinations, it was discovered that landfill soil coupled with laterite clay (50:50) stabilised with 20% RHA:PC (50:50) and POFA:PC (50:50) had the maximum compressive strength.

Anil et al. (2014) investigated the feasibility of using fly ash and rice husk in soil stabilisation. Five percent, ten percent, fifteen percent, and twenty percent of black cotton soil was mixed with fly ash. Rice husk ash was treated with (10%, 15%, and 25%), while rice husk ash was treated with (10%, 15%, and 25%). After 28 days of curing, the samples were divided into three groups (20%, 25%, and 30%).It was discovered that the liquid limit was dropped to 55% for he soil sample was combined with 20% fly ash and 25% RHA. For 20 percent Fly ash, the plasticity index was reduced to 86 percent, and when 25% RHA is blended with soil, the differential free swell is reduced to 5%.75 percent for a mixture of 15 percent fly ash and 20 percent RHA.

Sarkar et al. (2020) suggested the overview strategies for efficient crop residue management wherein crop production generates two kinds of products 1) Economic part (grains, seeds) 2) By-products (residues). The residues can be managed through sustainable green options and tradition management. Sustainable green options have been proven to be environmental friendly and are capable of generating useful products and employment opportunities (Fig. 3).

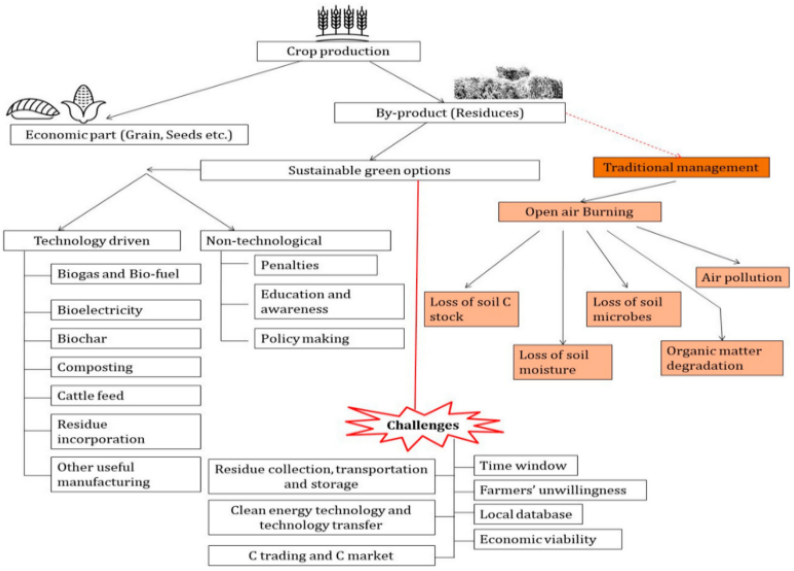

Fig. 1.Schematic overview and strategies for efficient crop residue management.

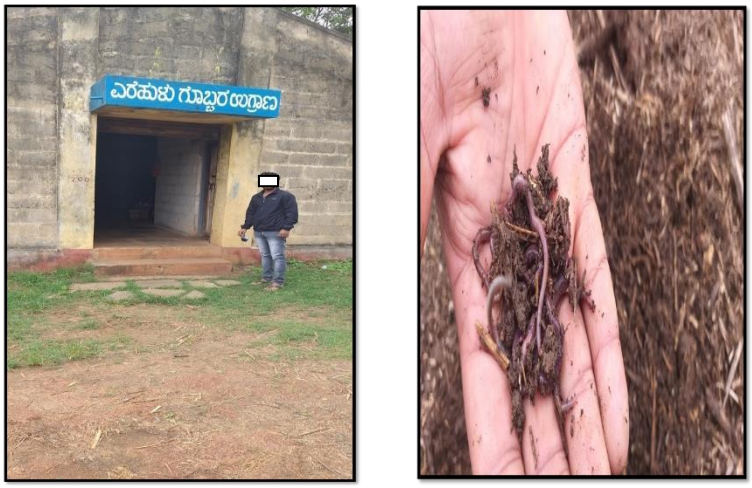

Fig. 4. UAS Dharwad vermicompost unit converting livestock waste into compost

3. RESULTS AND DISCUSSION

The major recommendations made by different institutions for Agriculture waste management are discussed below

The major recommendations made by ICAR Technologies for converting wastes from crops/ crop by-products into high value products: ICAR developed more than 100 products from agriculture waste like 1) Preparation of Handmade Paper from Jute Waste 2) Lac dye from effluent of sticklac Washing 3)Lac mud as organic manure 4) Fortified rice analogues from broken rice and dal.

Horticultural crops/crop by-products into high value products- 1)Tamarind seed husk reduces enteric methane emission 2) Pineapple fruit residue silage as fodder source for livestock 3)Oil palm factory Waste for mushroom production.

Animal wastes into high value products-1) Chitin and chitosan from prawn shell waste 2)Calcium from fish bones 4) Chitosan-based hand sanitizer.

Indian Agricultural Research Institute, New Delhi developed PUSA Decomposer capsule. Central Food Technological Research Institute (CFTRI) converting banana waste management sports beverage from banana stem juice.

Ministry of New and Renewable Energy-transforming electricity from agricultural waste in India
UAS Dharwad, has developed technology for converting agriculture and food waste into compost culture, Biogas, vermicompost etc.

3.1 India Thrust for Entrepreneur in NEP 2020

1. Preparing a roadmap for entrepreneurship given the explosive pace of technological development allied with the sheer creativity, the National Education Policy (NEP) promotes student entrepreneurs with the exposure to vocational education in partnership with industry and in alignment with the sustainable development goal.2.Era of specializations furthers, as part of a holistic education, the ideas of imaginative and flexible curricular structures enable creative combinations of disciplines for study. National Education Policy (NEP) provides for rigorous research-based specialisation by giving opportunities for multi-disciplinary work including industry; opportunities for internships with local industry/businesses-houses; actively engaging with the practical side of learning, all of which are bound to give impetus to entrepreneurship.3. Focus on technical education also, the focus on technical education is decisive for India's overall growth and development, and is well addressed in National Education Policy (NEP). Collaboration between industry and institutions to drive innovation and research is actively encouraged in National Education Policy (NEP).4.Integrating vocational elements Soliciting inputs from national and international entrepreneurs and practitioners; integrating vocational education programmes into mainstream education.5.Execution no doubt, the National Education Policy (NEP) is ambitious and futuristic for radical transformation of job seekers into job creators, but much of its success depends on its execution.

Already some national institutes working related agripreneurhip training programmes as well as waste management related activities namely.

The institutional initiations are as follows:

- National Academy of Agricultural Research Management (NAARM)-Incubation centers.
- International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) - Incubation centers.
- National Institute of Agricultural Extension Management (MANAGE)- ACABC programme,DAISY programme, Incubation centers , Agri-start up and subsidy, RKVY - RAFTAR .
- Indian Institute of Millets Research (IIMR) - Promotion of millets value addition .
- State Agricultural Universities (SAUs) - Incubation centers, RAFTAAR.
- National Institute of Rural Development and Panchayati Raj(NIRDPR)-Trainings on entrepreneurship (Phynol, honey bee, vermicompost, bio fertilizers.

Need for collaboration and strategies: Though many institutions are involved in research and development (R&D) activities, they work in isolation. There is a need to bring convergence and collaborative among various institutions to enhance effectiveness, reduce costs and reach larger populations. The possible collaboration initiatives are discovered below:

1) Consortia of institutes:

There is need for establishing consortia of institutes involved in research and development activities. Bringing them on single platform facilitates exchange of ideas, facilities and experience.

2) Joint Projects:

The leading institutions involved in agriculture waste management can take up joint projects. As cropping system change with agro climatic zones, such joint institutes cover large area as well as diverse crop.

3) Knowledge management:

The results and recommendations of various projects or institutions can be compiled to create knowledge warehouse. This can be made available in soft and hard form to stake holders.

4) Functional linkage with development departments:

As of now, national and state agricultural universities (SAUs) carrying out research activities and finding out measures to manage scientifically. There is a need to establish functional linkage with developmental departments so that they can communicate the measures more effectively.

5) National level and state level coordination committee on agricultural waste management:

The committee with representatives from SAUs, National Institutions and developmental departments at National level and state level can be established to monitor the developments as well as implementations of measures to manage agriculture waste. This committee can organize workshops at various levels to sensitize different stake holder.

3.2 National Education Policy (NEP)-2020- Opportunities for students in Entrepreneurship Development in Agricultural Waste Management

National Education Policy (NEP-2020) encourages on skill development and vocational trainings. It also gives thrust on preparing students for job or take up entrepreneurs. Agricultural waste management recycling opens up several opportunities for the students. The technology involved in the area of recycling as manure, converting into nutrient or energy source would provide ample opportunities for entrepreneurship development. This not only reduces ill effects on environment but also provides entrepreneurship opportunities.

Following strategies can be considered

1) Skilling in agricultural waste management as a part of curriculum in under graduation
2) One year programme to equip with necessary knowledge and skills
3) Training programme on agricultural waste management

4. CONCLUSION

There is need to establish collaboration mechanism to integrate the knowledge and skill and channelize for entrepreneurship development among students. It calls for coordination committee at state level to pool knowledge and skills developed at different institutions. One year modules for entrepreneurship development can be developed and introduced in all farm universities under NEP-2020.As the National Education Policy 2021 gives opportunity for multiple entry in the degree programmes, there is ample scope for introducing short courses on agri entrepreneurship at university level. Government should support infrastructure for adopting modern waste processing facilities by the farmers.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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