



Quarterly news bulletin – September 2019

Environmentally-beneficial resource management: waste-to-value

Last year at this time we had talked of how farmers, due to the paucity of time and the higher costs of mechanized clearing options, prepared for sowing the *rabi* (winter) crop by burning the *kharif* (summer) crop stubble in their fields. This has been worsening air quality, not only locally but wherever spread by prevailing winds. Alternative crop-stubble options that could enable some earning for the farmers – either mulching for soil nourishment or conversion to fuels – were described (<http://www.iei-asia.org/IEI-AsianewsletterSep18.pdf>). In this newsletter we first consider the problems that farmers continue to face with the field management of crop waste. We then describe another option: the use of paddy stalks and other crop stubble for the manufacture of table ware and packaging. These environmentally-benign products would serve the dual purposes of compensating farmers for not burning crop-stubble, and avoiding plastic production and disposal. As we approach the festive season, we have also to consider waste flowers; the large quantities that usually accumulate around shrines and proximate water bodies can be converted to useful products. Finally, while still on the subject of waste-to-value, we look at a case where an old cycle-wheel and remnants of other equipment have been assembled for use as a plough.

Clearing crop stubble: The uses of crop-stubble discussed last year included grinding into the soil for beneficial mulch, and conversion to fuels for heating and electricity generation. The fuels produced vary with the procedure selected. Through the densification and torrefaction routes one can produce pellets and briquettes; alternatively, where water is available, one can opt for fermentation/methanation, thereby obtaining ethanol or methane, with effluents usable as fertilizer.

Management of crop-stalks in the fields: The first option – mulching in the fields - that appeared to be easy, continues to be hampered by problems¹. While there is Government-support, in the form of subsidies for stubble-management equipment, there appears to have been inadequate interaction with the farmers regarding their needs.

First, the appropriate machinery has to be selected. For example, to mulch crop remnants and begin the next crop on the same ground, one should use combination-machinery such as a *zero-till happy-seeder* (as shown alongside) that pulverizes the old crop and also sows the new seed. Instead, *rotavators* were hired for mulching only: at least two months are required for decomposition of the crushed remnants before the new seeds can be sown, and the resulting delay leads to lower harvest returns. Further, such types of straw-management equipment are best suited for monoculture, while farmers need to (and actually do) practice more soil-friendly rotation between paddy and vegetables.



¹ Refer to “A quick fix”, *Down to Earth*, 1-15th November, '18, pp.16-18 for more details.

Secondly, the heavy combination-equipment requires tractors that are higher-powered (60 – 80 HP) than usually employed (30 – 35 HP); purchase of these is usually too expensive for the farmers, particularly as there is no subsidy for larger equipment. Worse still, dealers tend to raise the prices when subsidies are announced, thereby appropriating the benefits and leaving the cultivators with the same burden as before the subsidy. Further, this assistance is only available as a reimbursement (often after several months) of expenses already incurred, so that initial purchase continues to be difficult.

Due to the price burden, farmers try to hire rather than purchase the equipment. But even the farmers' associations/co-operatives have very few pieces of equipment; the number of machines available currently just cannot meet the needs of stubble removal within the available window of about three weeks. Moreover, these are usually lent to large land-owners whose bills would be adequate to cover the additional cost of transport.

Alternative uses for crop stubble: However, apart from the options described earlier, there are innovative procedures of utilizing such crop waste, where the value of the output could justify the additional costs of stubble removal, transport, and processing. These have recently been demonstrated and even come into use.

Paddy-stalks to tableware: At Kriya Labs (<http://www.kriyalabs.co.in/>), a start-up incubated at the Indian Institute of Technology (IIT)², Delhi, a machine and process have been designed to convert paddy straw into mouldable pulp. Kriya Labs has patented this technology and set up a functional prototype of the machinery at the IIT-Delhi campus.



The rice-straw collected in the fields has to be chopped into small pieces and then brought to the processing unit. The mud is washed off (currently in washing machines) after which the straw is treated with a natural solvent. The mixture is steamed and a mechanical shearing force applied, to make a semi-solid pulp; this is further cured and strained to obtain the required pulp. After drying, the pulp can be moulded into cups and plates (as shown here).



The Kriya equipment is preferable to traditional heavy machinery which is not viable for small-scale operations. Moreover, small machinery can be used for processing near the pulp sources, avoiding transport that is both tedious and expensive. Kriya intends selling small pulping machines to groups of farmers so that they can produce stalk-based pulp themselves, thereby establishing a direct connection between agriculture and manufacturing, and empowering rural youth. Kriya will guarantee purchase of all the pulp produced using their machine and process. Even the farmers not involved in the processing could benefit from the sale of their paddy straw. Partnering with local entrepreneurs and farmers in Ludhiana, Kriya Labs is setting up a processing unit to convert rice straw into pulp.

² Kriya Labs was founded and is led by Ankur Kumar, Kanika Prajatat, and Pracheer Dutta. They were assisted by Foundation for Innovation and Technology Transfer (FITT), a registered society within IIT-Delhi, which helps start-ups with services like access to seed funding, operational guidance, and marketing aids.

Other biomass to tableware: There are already firms that manufacture bio-degradable tableware and packaging from crop waste, thereby replacing non-degradable materials and imputing value to what used to be “waste”.

Ecoware (<http://ecoware.in/>) is currently India’s largest sustainable food-packaging company. Its range of 26 products includes plates, bowls, cutlery, trays, and takeaway packaging (some shown here). All the products are made from plant biomass -- commonly the waste of wheat and sugarcane. As explained by their CEO³, the pulp is produced in a manner that no chemical or pesticide residue is retained, so that there is no contamination of the food contained. The products are expected to be bio-degradable (compostable) in 90 days. The vessels are meant to sustain a temperature range from -20 to 180 degrees Celsius, so that they can be used in a freezer or refrigerator, as well as a microwave/conventional oven.



PAPPCO Greenware (<https://www.papccoindia.com/>)⁴ also manufactures disposable tableware from several types of crop remnants – sugarcane, wheat straw, and bamboo fibre. Their products (shown alongside) are purchased by fast-food chains in India and abroad.



Commercial demand for straw/stalks will encourage farmers to cut rather than burn crop stubble, and possibly get involved in forward linkages; this would not only help the environment with reduced air pollution and alternatives to plastic/Styrofoam, but improve rural livelihood.

Meanwhile, the Indian Railway Catering and Tourism Corporation (IRCTC) has re-introduced the *kulhad* – baked-clay cups (shown here) for beverages. These vessels were brought into use at the stations at Rae Bareli and Varanasi (in the state of Uttar Pradesh, northern India) earlier this year, and their use is expected to be extended throughout the country. The Railways’ demand would have a huge impact on the livelihood of the communities involved, while also replacing the use of non-degradable materials. The Khadi and Village Industries Commission (KVIC) has begun supplying electrically-powered wheels to potters to increase the speed of production. The introduction of bio-degradable materials for other vessels and meal trays is also being considered.



³ Ecoware was founded and is led by Rhea Mazumdar Singhal; she was awarded India’s *Nari Shakthi Puraskar* (Women Power Prize) for her work on sustainable packaging.

⁴ PAPPCO was founded and is led by Abhishek Agarwal.

Conversion of flowers for usable products: As the festive season approaches, one has to consider the usual accumulation of “waste” flowers that have been used in offerings and decorations but later lie in rotting heaps on land and float on water bodies.

Fortunately, through the efforts of HelpUsGreen⁵, a method of successfully converting waste flowers (and stems, leaves) to attractive useful products has been demonstrated. These products (www.phool.co) include charcoal-free *Phool* (flower) incense sticks and cones, from the flowers (shown alongside), organic vermi-compost, from the other remnants of the plants, and *Florafoam* packaging material (a biodegradable alternative to thermocol).



HelpUsGreen operates in the state of Uttar Pradesh, and their efforts are intended towards cleaning the river Ganga. A natural formulation -- comprising activated carbon from the seed of Indian black plum (*jamun*), which gets rid of fluoride and lead, and five other ingredients - - is used to detoxify all major insecticides/pesticides from the flowers/stalks/leaves. The residues are washed off, while a neutralising agent is used to make the water non-toxic; this water is then re-used to make vermi-compost. A leather-like material made entirely of flower waste has also been developed. It is mouldable, “breathable” - permitting the passage of air, has a high tensile strength, and can be dyed in numerous shades. It could therefore be used as an alternative to leather.



Apart from the value addition of these products and the prevention of pollution of the river Ganga, the enterprise provides regular employment, and thereby improved living standards, to women whose families were earlier manual-scavengers. “Flower-cycling” thus constitutes an integrated eco-friendly solution to the disposal of waste flowers. HelpUsGreen was among those honoured with the United Nations Climate Action Award at the UN Climate Change Conference (COP 24) in Katowice, Poland.



Discarded cycles to manual plough – It was said that swords would be converted to ploughshares⁶; while that prophecy is not being fulfilled, remnants of old equipment including a cycle wheel, have been fashioned into a plough!

Recently, the northern part of Karnataka state (in south-west India) has suffered double blows: severe drought followed soon after by a devastating deluge that resulted in extensive flooding. Over 1,400 cattle deaths have been reported, including 214 in Dharwad district. Even without these additional difficulties, animal-drawn ploughs are increasingly rare, due to

⁵ HelpUsGreen was founded and is led by Ankit Agarwal.

⁶ “-- they shall beat their swords into ploughshares and their spears into pruning hooks: nation shall not lift up sword against nation, neither shall they learn war any more.” Isaiah 2:4.

the difficulties of caring for cattle. Hence, preparing the fields with cattle-drawn ploughs would be near impossible. The costs of the alternative - renting and fuelling a tractor-tiller - are too high for small farmers, as the crop-returns to un-irrigated land are low. There are state-subsidised schemes and programmes intended for assistance with farm equipment, but those with larger fields tend to get first access.

However, a farmer in Kusugal village, Dharwad, recalled seeing a bicycle wheel used to help plough a field. Hanumanthappa Balesoor has constructed such an apparatus. He has fitted two wooden spikes to the hub of a cycle wheel so that the spikes are dragged, with the effect of a plough, when the wheel is pulled along. This cycle-wheel plough is pulled from one side, and steered on the other side with handles, also attached to the hub. While this is laborious work, taking as long as 3 hours per acre for a two-person team, there is no other option, as the family had to sell the pair of oxen they owned earlier, merely to survive. They have the satisfaction that no fuel is needed and there are no additional costs.



The equipment is being used not only by this family but also when lent to other farmers – in yet another case of remnants transformed for benefit!

*Antonette D'Sa
IEI-Asia
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