

Mechanization in Agriculture and On-farm Agro-processing¹

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1. Introduction

Mechanization in simple terms is interjection of improved tools, implements, machines and other equipment between man and materials. In agriculture materials are soil, water, environment, seed, fertilizer, pesticides, growth regulators, irrigation, water agricultural produce and by-products such as food grains, oilseeds, fruits and vegetables, flower and other ornamentals, spices and condiments, cotton, jute and kenaf, milk, meat, eggs, fish etc. There is scope of mechanization in every unit operation of production agriculture, post-harvest management and rural living. It is directed to enhancing workers output, multiply human effort, supplement and substitute human labour that is enabling and removing avoidable drudgery or stress that adversely affect human mental faculties leading to error, imprecision and hazards and eventually loss of efficiency. It imparts dignity to work removing taboos associated with certain farm operations. It contributes to agricultural productivity through assuring timeliness, precision in metering and placements of inputs effecting economy in input use at the same time enables plants and animals express themselves better. Improved process and equipment and management techniques help in conservation of agricultural produce, residues and by-products against qualitative and quantitative damages, value addition, agro-processing entrepreneurs generating additional income and employment. Mechanization is also needed in domestic activities and rural living. Mechanization stands for modernization and material culture of any society.

2. Evolution of Mechanization in Agriculture

Mechanization has its roots in antiquity. Harappan people around 2500 BC transformed themselves from hunter gatherers to settled farmers-cum-semi-pastoral livestock herdsman. It was made possible by preceding inventions, in Paleolithic periods like around 50,000 BC fire wood as digging tool, stone and

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bone tools for digging, cutting. Agro-pastoral life forms started appearing around 6000 BC. Domestication of plants and animals, invention of tools and implements, skills and accessories of using draft animals for agriculture and transport during Neolithic periods (5000-3000 BC). They invented ploughs, carts, sailboats, fishing hooks, nets and traps, grain-storage and primary processing equipment. Grand granaries of Harappa had aeration columns, saddle querns and mortar and pestle around storages work there for primary processing. With copper smelting during Chalcolithic period (3000-700 BC) and later its alloy bronze, these tools and implement got refined and made more durable. Harappan civilization with its urbanization, international trade flourished during the Bronze Age. However, it was during Iron Age (1000 BC), a continuous built up over Chalcolithic and Bronze Ages, the iron metallurgy heralded a new era of cultural advancements and mass movements in agrarian life styles. Iron which is much more durable, available in plenty and cheap became principal metal for tools used for forest clearing and expansion of farming villages. By 400-300 BC use of iron was common all over India but preceding ages tools and equipments existed simultaneously in remote hilly and forest areas, a phenomenon that persists even today. A review of the traditional agricultural equipment still in use establishes that tools, implements and transport vehicles developed during the Harappan period are their progenitors. Over the ages, the basic designs have remained same except for improvements in materials of construction, metallurgy and craftsmanship. It was invention of iron and steel and their large-scale use in farm equipment that enabled rapid expansion in settled agriculture. It is a tribute to the Harappan people and those who followed them that the technologies evolved by them could maintain continuity during the succeeding millennia and were valued as part of material culture of the people.

3. Agricultural Mechanization at Independence

In 1947, Indian agriculture used mostly traditional farm power sources and farm equipment – bullock drawn ploughs, wooden peg tooth harrow; wooden plank for pulverization, compaction and smoothening, bullock carts and hand tools such as khurpi, crowbar, spade, hoe, sickles, daratis, axe, chopper, dau etc. Irrigation water was lifted using animate sources like swing basket, centrepoise lift, Mhote/Charasa/Sundiya and Parsian wheel etc. Some philanthropists, facilitated by colonial masters were trying to introduce western soil inversion 15 cm long beams plough (Meston). The only mass manufactured items were spades, pickaxe, crowbars, and watering buckets manufactured by Tatas. Traditional farm equipment were made by local craftsmen using locally available materials without standardisation and quality control. There was lot of variability region to region as revealed by the survey undertaken by ICAR in 1950s.

Starting with Battle of Plassey 1757 British East India Company became colonial masters of India by 1857 and the British ruled till 14th August, 1947. It

was the period during which industrial revolution brought prosperity to Europe, America and Japan with colonies as captive markets and suppliers of cheap raw materials. India through its self-reliant villages maintained its economic prosperity till mediaeval periods. The villages were basically producer-cum-primary processors. Industrial revolution and advent of electro-mechanical machines doing processing better and at much cheaper rates rendered traditional industries non-competitive. And a policy of treating India as supplier of raw material and market of processed good rendered rural India just a producer of raw material. At the time of independence rural people used traditional stone grinders for atta and dal preparation. Rice was obtained from hand and foot operated pounds (mortar-pestle) cleaning by wind and cleaning basket. Oil was extracted using bullock drawn kolhus. Tribals used petula for oil extraction. These left 15-25% oil with the cake. Urban people had access to burrmill for atta, huller for rice and expeller for oil extraction. After independence every central and state government have tried to re-establish on-farm/rural agro-processing.

4. Growth in Agricultural Mechanization

Efforts to have improved farm equipment started soon after independence. However, Green Revolution in 1967-68 particularly brought to focus the need for agricultural mechanization for efficiency in farm operations and efficient use of scarce and costly inputs. First few bumper harvests rendered traditional post-harvest infrastructure inadequate, resulting in to excessive harvest and post-harvest losses. It resulted into post-harvest technology as one of the thrust areas and a new multidisciplinary area of R & D.

5. Introduction of Pumping Sets

The Green Revolution was triggered by scientific and technological inputs accompanied with upstream and downstream support systems. Technological package included mechanization in natural resource development, agricultural field operation, input applications and on-farm primary processing. After intensive testing and evaluation in late 1950s irrigation pumping sets got into indigenous manufacture, two-third engine operated and one-third electric operated. As rural electrification advanced proportion has reversed. Animal drawn improved MB ploughs, harrows, puddlers, implements such as seed drills, seed-cum-fertilizer drills, 5 hp power threshers using primover of the pumping sets, got into manufacture and use.

6. Indigenous Manufacture and Use of Tractors

Central Tractor Organisation (CTO) established soon after independence to reclaim marshylands and scrub forests to settle displaced people set the pace of

tractorisation in India. CTO used crawler tractors; their operation and maintenance was by Indian operators. After initial stocks of spares ran out, indigenous manufacture of critical fast wearing parts started. For tractorisation of seedbed preparation, sowing and transport etc. 4-wheel General Purpose tractor were imported CKD (completely knocked down), assembled, marketed, operated and serviced by Indian human resource. The confidence gained resulted in progressive indigenous manufacture. 'Swaraj' 35 hp from M/s Punjab Tractors was the first fully indigenous tractor manufactured in India. Looking to predominance of small and marginal farms 2-wheel tractors popularly called Power Tillers were introduced, after the introduction of 4-wheel tractors. However, power tillers could not face competition with tractor industry and their use did not expand as rapidly as of the tractors. Today India is the largest producer of tractors in the world with about 2,75,000 tractors per year and about 15000 per year power tillers. China is able to market its power tillers in India at cheaper prices, nevertheless there are after sales service problems in many cases.

7. Farm Equipment

With the introduction of tractors and power tillers in India in a big way the development, adoption, and production of matching equipment for land leveling, seed bed preparation, seeding and planting, seed-cum-fertilizer drills, sprayers and dusters, harvesters and power threshers, 2-wheel and 4-wheel tractor trolleys etc. started in a big way. Farm implements got reserved for the small scale industries (SSI). It became very competitive farm equipment industrial activity in Punjab and in pockets all over the country. However, to enhance quality many items have been deserved now.

A large number of improved farm equipment have been designed, developed, adopted and good many commercialized relating to land and water resource development, irrigation and drainage, seedbed preparation in both upland and wetland situations; sowing, planting and rice transplanting, interculture and weeding, spraying and dusting. Serrated sickles, fruit pluckers, vertical conveyor reapers-walking, tractor driven, and self propelled and combines-tractor mounted, tractor driven and self propelled have been well received by the farmers. Custom power threshing have come up in a big way specially in rice-wheat eco-systems. This has put demand for high capacity bulkfed power threshers (upto 1-1.5 t/h grain capacity). Power threshers have been developed for large number of field crops. Many of them are multicrop. Combining, for crops it works, is the cheapest option. However, it leaves straw on ground creating its use and disposal problem. To tide over this problem straw combines have been developed. But still many farmers, incinerate the straw to get rid of them. However, horticultural crop cultivation, livestock husbandry, and fishery continue to be excessively labour intensive. It is proposed to address to horticultural crop mechanization during X Plan.

For transport of farm produce, inputs and marketable surplus there are wide range of traditional and improved transports in use. However, for various reasons transportation on head, shoulder and animal back continue to exist. Transport of marketable surpluses to markets and distribution centers specially of perishables like fruits and vegetables and animal products is not satisfactory and very expensive demanding R & D inputs on priority developing affordable cold chain.

8. Post-Harvest Equipment

Processes, processing equipment and management practices are vital to minimize post-harvest losses, hold and store perishables to negotiate with the forces of marketing and realize due dividends through value addition and agro-processing. Manual and power operated shellers, decorticators, dehuskers, cleaners and graders have been developed and commercialized. Through these on-farm value addition activities farmers can earn more and retain waste and by-products of feed, fibre, fuel and manure value on the farm itself. Drying is a very cheap and reliable method of extending shelf life. High moisture food grains, oilseed and other farm produce suffer severe qualitative as well as quantitative damages. Solar, solar-cum-rice husk/crop residue fired, oil fired and electric heated tray, batch, recirculatory and continuous dryers are available in the market. However crop dryers are not yet popular for on-farm use needing intensive extension efforts.

9. Storage

Consumers of about 65% of the agricultural commodities of food, feed, fuel or fibre value are rural people who retain cereals, pulses, oilseeds etc. if possible, for family consumption and dispose only surpluses (on average about 35%). On-farm traditional storages have exclusive losses. Improved storages for home and on-farm storage of food grains prophylactic and curative practices have been developed. However, farmers find it difficult to safely store legumes as a result they sell them immediately after harvest when the prices are generally low suffering economic losses, a disincentive in pulse production. For certain perishables, in hot dry weather, evaporative cooled storages have been found useful extending shelf life substantially. Public and private cold stores, CA and MAP storages and onion storages are in use. Deptt. of Agriculture and Cooperation, Govt. of India are promoting cold stores and onion storages through a back ended capital subsidy scheme.

10. On Farm Milling and Processing

For realizing due dividends from agricultural produce and residues on-farm milling and processing is essential to meet local needs at the least cost,

efficiently handle and use by-products and waste, and market the surpluses after value addition. Rural India used to be producer-cum-primary processor however, during colonial periods primary processing was not encouraged and technologically rendered non-competitive. There are several middlemen between the producers and consumers adding 25-50% consumer price even to rural consumers. To enable rural sector to meet its own needs at least cost and market value added products for additional income and employment processes, equipment and pilot plants have been developed like mini-rice mills, mini-dal mills, mini-oil expellers, mini-grain mills, soy-milk-cum-tofu plants which are commercially available. Models of Agro-Processing Centres have been developed that at an initial investment of Rs. 2-3.5 lakh give full time employment to 2-3 people and have return on investment (CI) of 40-100%. It is a linkage that grows with mechanization in agriculture providing incentives to investments to increase production and productivity.

11. Policy Issues and Quality Assurance

Agricultural mechanization is a relatively less regulated sector. Usually demands are made for "appropriate mechanization" which bring economic competitiveness and remove avoidable drudgery. A draft agricultural mechanization policy has been developed by DAC in cooperation with ICAR.

To protect the farmers interests, GOI has requirement of testing and certification before introduction of a new farm equipment. BIS standards and certification is there for quality assurance which are getting increasingly closer to ISO. Globalization has put special demand on manufacturers to assure quality to remain competitive.

The National Commission on Woman is putting pressure on R & D organizations and developments to remove drudgery to farm women. Some 17 hand tools and implements are under evaluation.

To save the operators, removing hazards, GOI has enacted Dangerous Machine Regulation Act which is being enforced by the States. BIS has developed a number of safety standards. In food and agro-processing CODEX, and HACCP have become relevant and being encouraged.

12. Emerging Trends

Agricultural mechanization trends are linked with the trends in agriculture, agro-processing and rural living, globalization of world markets and market trends, WTO obligations, and State and Central Government policies and demands of political constituents. Agriculture is a State subject. Decisions at state or regional level for self-sufficiency or policy to concentrate on exploiting agro-ecological advantages and meeting short falls through imports from other States of the Union or a foreign source are likely to affect the mechanization

trends. As of now things are in the state of flux. Modernization requires sophistication in mechanization which is possible at relatively large scales of operations with capital and management constraints overcome. Globalization puts heavy demand on competitiveness, reduced unit cost of production, indirectly demanding mechanization and to a certain extent automation leading to loss of job. These will lead to tractorisation. Marginal and small farmers are increasingly becoming part time, absentee farmers, periurban farmers, wage earners on part or full time basis. Industry and service sectors, trade and commerce unable to reduce land based livelihood compel the rural people to remain on land based livelihood, forcing steady increase in number of land holdings but average land holdings going down making mechanization more challenging and difficult. Scaling down of farm machines reduces mechanical advantages. Instead of owning farm machinery other than hand tools such marginal farms can meet their needs through custom servicing, if it is well developed.

Country is faced with the basic livelihood issue of the rural masses. With per caput arable land availability dwindling and average land holding coming down to levels that it is too difficult for the farm families to have minimum acceptable standards of food, shelter, clothing, health care, and education, the Central and State Governments are seized with the issue of ways to widen livelihood base of these people. Increasing productivity; crop diversification towards horticulture, livestock husbandry, fishery and forestry; post-harvest management for minimization of post harvest losses, value addition and agro-processing for additional income and employment are some of the developmental measures enunciated and related schemes and programmes launched.

DAC, Government of India have launched Agri-clinic and Agri-business Scheme that is going to supplement and substitute some of the extension functions and services rendered by the public sector extension. It is envisaged that entrepreneurs will be providing custom service to the farmers besides other services which will need machines of large capacity. The entrepreneurs will be also taking agro-processing, packaging, transport and marketing activities both for domestic and foreign markets.

Governments are also encouraging contract farming i.e. farmers producing specified agricultural produce needed as raw material for industries. Governments are also reducing intermediaries between growers and consumers. Growing middle classes where both husband and wife are working need processed and semi-processed, ready to cook, ready to eat items.

Under such complex scenario the emerging trends in mechanization of agriculture, agro-processing and rural living are as follows

13. Farm Power Units

1. Animate energy, both human and draft animals (DAP) will continue to be important sources of farm power specially on small and marginal farms, hill agriculture, horticultural crop cultivation, animal husbandry and fishery. However, use of DAP is likely to maintain its declining trend and may stabilize around 20-25 M pair of bullock equivalent. Due to lack of opportunities in other sectors of Indian economy, use of human as farm workers is likely to grow but at a slow rate with elements of under employment.
2. There is going to be increasing demand for riding type farm equipment. Animal drawn tool carriers under different brand names are going to get in use if refined. Likewise riding type power tiller farm operations will be in demand. Some power, no doubt is lost in transport of the operator and the tool carrier, but the loss is more than made up through gain in net operational time due to favourable work-rest cycle in a riding type man-machine system. Drudgery to the operator is minimized.
3. R & D in yokes and harnesses, draft ability studies are going to create more dynamic DAP use systems, use of unequal animals, DAP of two different species are likely to come up.
4. Small engines (1-3 hp) for handheld and knapsack power operated equipment for pruning/chopping, hedge trimming, cutting of bushes, tree felling, tea harvesting, spraying, and dusting etc. are likely to become popular.
5. Due to global competition agricultural engines - diesel, petrol, kerosene, biofuel are going to be better through superior metallurgy and manufacturing processes. Advances in combustion chamber designs, fuel injection etc. is going to make them more fuel efficient. Noise and vibration problems are going to receive greater attention.
6. Paucity of petroleum reserves is going to bring biofuels - alcohol from sugarcane, molasses, corn cob etc. and non-edible esterified vegetable oils for use as biodiesel.
7. For stationary shaft power operations, electrical power generation, and process heat for agro-processing alternate energy sources such as producer gas from crop residues, farm and roadside grown energy plantations, processing wastes like rice husk, groundnut shell etc. are going to find greater acceptance. Solar Thermal System and Thermal Power Units run on crop and agro-processing residues are likely to gain popularity as stand alone power units.
8. Light weight and modular PT for hill agriculture/terraced farming are going to appear using diesel and biofuels.
9. Average farm power availability is going to go up from current 1.15 KW/ha to 2 KW/ha for desired intensity of cropping and to ensure timeliness.

14. Farm Implements and Machines

1. Improved energy efficient matching implements and machines for different unit operations of agriculture are expected to be available soon.
2. For timeliness, efficacy and reduced unit cost of operations single-run machines are going to gain acceptance.
3. High speed ground machinery for tillage, sowing, and planting using rolling, rotary and vibratory actions will be introduced in future.
4. Custom hiring in seedbed preparation, sowing, planting, transplanting, harvesting and threshing and other specialized unit operations where ownership of a costly equipment is not justified will be much in demand.
5. Microprocessor controlled equipment for land grading, seeding, transplanting, and farm machinery management.
6. Trade in used farm machinery, repair, reconditioning is likely to come up in order to reduce capital requirements of farming.
7. General improvement in quality of farm machinery is likely to be achieved compelled by global competition, export prospects through R & D, standardization, and quality control measures and advanced manufacturing methods.
8. Use of plastics in farm machinery manufacture specially for hoppers, handle grips, conduits and tubings, metering devices, surface coating and components requiring resilience or corrosion resistance etc. Advances in polymer chemistry and precision in injection mouldings can turn out cheaper nozzles and control valves, gear drives.
9. Components and whole equipment designed with ergonomic rigour conforming to anthropometry of workers, and operated on scientifically established work-rest cycles are going to be there. Working postures are likely to change from bent and sitting to erect postures for greater work output and less strain on body.
10. Conventional tillage and sowing are going to be supplemented and substituted by rotary tillage, conservation tillage, raised-bed systems for economy, efficacy, and enhanced productivity.
11. Conventional Biasi, Lehi, and manually transplanted rice are going to be supplemented and substituted by mechanical transplanted rice using manually operated and self propelled transplanters and mat type nursery. Dry drilling and paddy sown with pregerminated paddy seeder in levelled puddled field (Lehi substitute) have already made in-roads. Check-row transplanted and bidirectional mechanically weeded paddy crop has yield advantages and thus likely to gain ground provided affordable check-row planters and efficient weeders are developed and made available.
12. Zero-till drill and raised bed planters in rice-wheat ecology are going to become still more popular for the economy in use of irrigation water

(35-50% saving), reduction in unit cost of production (1500-2000 Rs/ha), better control on phalaris minor and yield advantages (about 5%).

13. Mechanical weeders - manual, animal drawn, power tiller and tractor mounted and self-propelled power weeders for wide row as well as rice-wheat are going to be in greater use and would be available in wide range.
14. Sugarcane planters; cutter-planters which makes sets, plants, applies fertilizer, weedicide and pesticide in one go are going to gain popularity.
15. Sugarcane stubble shaver and ratoon management equipment are going to be in demand.
16. Drills and planters for direct seeded vegetables, vegetable transplanters for potted and soil block mature seedlings of brinjal, chillies, cole crops, onion, garlic etc. are expected to be in use as vegetable cultivation gets commercialized.
17. Polyhouse nursery - conventional, potted, and soil block as well as semi-automatic nursery are going to come up.
18. Pressurised irrigation systems - sprinklers, micro-sprinklers drips, fertigation, skiprow, irrigation for water conservation and enhancement of water use efficiency, and associated yield advantages. On-farm agricultural drainage - surface, sub-surface and vertical are going to be integral part of on-farm water management. Drainage not only improves productivity but also influences such factors as lodging of the crop along with seed rate and N-application. Mechanization in laying drainage system is going to gain grounds.
19. Wide boom and high ground clearance sprayers, tall tree sprayers and dusters, turbofan power sprayers and dusters/aeroblast sprayers and dusters will come in greater use. Environment pollution associated with spraying and dusting and pressure being mounted by environmentalists is likely to give rise to use of electrostatic spraying and dusting which has better impingement and very little drift.
20. Sickle harvesting of cereals, specially rice, wheat etc. is being substituted by reaping with vertical conveyer reapers - walking, riding, and PT and tractor mounted. These equipment will be in greater demand.
21. Power threshing is already in vogue for most of the crops through owned or custom hired power threshers. Trend is emerging in favour of large capacity, bulk fed, multicrop threshers. There are going to be power threshers for difficult to thresh crops like pigeonpea.
22. Use of standard grain combines for large number of cereals, pulses, and oilseeds are already there growing @ over 10% annually. Demands for grain combines, plot combines is going to rise.
23. Harvesters for commercial crops like sugarcane, cotton are going to be there in not too distant future. Forage harvesters and forage combines and hay making equipment are going to be in demand.

24. Agri-electronics has emerged as an area for R & D and going to make available a number of rugged, user friendly, affordable electronic gadgets to practice precision farming like pH meter, water quality analyser, macro and micro-nutrient analysers, machine vision for plant growth management, analysers for determination of quality of produce electronic ultrasonic pest repellents, electronic bird scarers etc. are some of the possibilities. Robotics in fruit and vegetable harvesting have already been field tested in developed world where labour is very expensive. Automatic irrigation systems are in use already in India at pilot level.
25. Organic farming gaining momentum is going to have improved equipment for incorporation of biomass in the soil, FYM and compost spreaders. Slurry pump, tanker and slurry applicators are also going to be in demand to recycle solid and liquid wastes of livestock. Mechanized composting has now better chances of acceptance.

15. Agro-Processing

1. On-farm produce management is going to receive greater attention to minimize harvest and post harvest losses from qualitative and quantitative damages. This entails harvesting at right time, using right harvesting tools, implements and machines, handling of the produce in a manner that mechanical, weather and physiological damages are minimized specially in fruits and vegetables.
2. On-farm value addition for additional income and employment and ease of marketing and retaining processing and milling by-products of feed and fuel value on the farm itself at the same time saving in handling, transport, storage, packaging costs etc. This is going to put dehuskers, shellers and decorticators, cleaners and graders in greater use. There are going to be mechanical washers and fruit and vegetable packaging lines.
3. Agro-processing to meet local needs of rice, atta, dal, oil, ground spices, fruit and vegetables and livestock feed, concentrates using mini-grain mills, mini-modern rice mills, mini-exPELLERS and batch solvent extraction units, hammer mills, mixers, bagging and stitching units etc. are going to be there in production catchments.
4. Urban middle classes are looking for ready to cook even ready to eat items. This is likely to give place to soy-milk and tofu plants both in rural and urban areas. Minimally processed vegetables and fruit juice concentrate, jam, jellies, candies etc. can be produced in production catchments and supplied directly to retailers at much lower consumer prices. Such processing units are going to come up.
5. Scientific storage avoiding distress sale and providing off-season supply is a value addition activity. Warehouses, silo storages, storage in evaporative cool chambers, cold storage, onion storages have good prospects and likely to come up in a big way.

6. Drying is an age old method of preservation of agricultural produce and to have long shelf life food products from perishables, mostly sundried. Heated air dryers - batch type, batch-in-bin, recirculatory, and continuous type are there for foodgrains and such particulate materials, some of these are in use at millers level already. On-farm mechanical drying is likely to come up to save moist grains from discolouration and from microbial damages. Tray dryers are widely used for drying fruit and vegetable slices. For on-farm drying of fruits and vegetable solar-tray dryers have been developed and are gaining acceptance. Osmodehydrated fruit slices are very appealing and organoleptically rated high. Scraped surface dehydrators are likely to come to concentrate milk in to khoa and other such applications.
7. Agro-Processing Centres appropriate for different production catchments using modern processing equipment matching to the scales of operation are going to come up enabling producers meeting their own needs at the least cost at the same time market surpluses after value addition.
8. To handle, storage, transport, and market perishables cold-chains are needed. Available ones are too expensive. Indigenous cold-chains are going to be there for different commodities. In a way it exists for milk, fish, meat etc. However, greater innovation and creativity is expected in this area.
9. Processes and pilot plants are expected producing speciality diet foods like soy-milk, tofu, soy-fortified biscuits, soy-yogurt, soy-icecreams, tempeh burgers etc.
10. Processes and pilot plants are going to come up for powder and liquid jaggery, beverages from sugarcane and traditional fruits.
11. Particle board and timber substitutes made out of jute and kenaf sticks, paper and pulp from jute cuttings, sticks, and whole plant; craft paper and corrugated board packaging boxes out of cotton stalks are demonstrated already more commercial units are likely to emerge.
12. Mini-jute spinning system developed at NIRJAFT on the pattern of khadi making utility products from jute fibre and their blends holds promise.
13. Cotton ginning and baling is being modernized under Technology Mission on Cotton which is going to put in place high efficiency roller gins, sawgins, precleaners, electrically controlled balers, and mechanical handling systems in modernized ginneries which should cotton trade and textile industry.
14. Processes and pilot plants are going to come producing seed lac, shellac, bleached lac, lac wax, paints and varnishes, edible grade lac dye, valuable chemicals from lac and its by-products.
15. Jute and textile industry are going to experience greater modernization and automation.

16. Jute and kenaf ribboners and decorticators to enable ribbon retting for quality fibre and minimize pollution are going to come in use.
17. For profitability and sustainability of commercial crops thrust on diversified uses is likely to continue demanding development of new processes and equipment to realise the prospects.

16. Rural Living

1. In a village eco-system, 80% of the total energy spent goes to domestic sector and of that 80% goes for cooking. Fetching of drinking water, collection of fuel wood are ordial to rural women and children. Rural kitchens are full of smoke, ill-illuminated, cause of many health hazards. Quality of fuel decides quality of life to an housewife, rural or urban alike. In that scenario biogas stoves, pyrolysed briquetted fuel and sigdi, biogas lantern, biogas run ovens; solar cookers - individual and community type, solar water heaters are under promotion and are likely to increase in number supplementing and substituting conventional cooking and water heating.
2. With the rural electrification in India, refrigerators are reaching rural homes which provide capacity to store perishables safely and prevent wastage.
3. Pressure cookers which are energy efficient are also reaching rural homes.
4. Other kitchen appliances like mixer grinders, electric iron, electric fans and lights are being used in electrified villages.
5. Butane supply to rural areas is gradually spreading which is going to conserve fuel wood and other biomass for organic recycling.
6. Smokeless cooking stoves that are energy efficient therefore, are under promotion already in a big way.
7. Hapur kothis, metallic air tight storage bins have found acceptance that keep the food grains safe protected from rodents, and enable fumigation in the event of infestation.
8. Ata chakkis are doing custom milling likewise motorised wet grinders have become popular reducing drudgery in rural home. Single phase electric motor run cleaning grading and size reduction equipment also open avenues of custom servicing to other.
9. Rural water supply and sanitation and rural roads and public transport are gradually growing. Dry and wet type bore hole latrins provide cheap sanitation to rural homes.
10. Biogas plants, composting, vermi-composting allow rural people to convert organic wastes into wealth extracting energy, and plant nutrients in litter free, fly free, incineration free manner.
11. Rural agro-processing centres and other home level agro-processing and craft activities using mini-burr mill, solar dryers etc. are enabling additional income and employment in spare time.

17. Status of Agricultural Mechanization Database

Weak Farm Mechanization Database

- Draft animal power time series data
- Unreliable data on farm machinery industry specially small and cottage sector level
- Farm machinery number and geographical distribution
- Precise use of animate and commercial energy (limited data from AICRP-ERAS)
- No reliable data on demand of farm equipment

18. Possible Strategy

1. Technical Committee on Farm Mechanization On-farm Agro-processing to undertake special surveys
2. Deeper involvement of INARIS with agricultural mechanization
3. Agricultural Statisticians should include agricultural mechanization, agro-processing and rural living as one of the areas of activity
4. Sponsored projects on these aspects

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