Pakistan J. Agric. Res. Vol 23 No. 1-2, 2010.

PRESENT STATUS AND FUTURE PROSPECTS OF MECHANIZED PRODUCTION OF OILSEED CROPS IN PAKISTAN-A REVIEW

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ABSTRACT: The domestic production of edible oils is critically insufficient to meet the demand of growing population. It only meets 27% of the total edible oil consumption in the country. The deficit is met through import of edible oils from other countries on which government is spending billions of rupees in foreign exchange. It is imperative to mention that the efforts made so far at federal and provincial levels to increase the production of oilseed crops are not fruitful. This crop sector remained neglected for the last two decades due to mainly unfavourable edible oil import policies. Three main institutions/organizations namely Oilseed Programme NARC, Agricultural and Biological Engineering Institute (ABEI), NARC and Pakistan Oilseed Development Board (PODB) Islamabad are jointly working at federal level on the development and promotion of oilseed crops. More precisely, Oilseeds Programme is working on the development of new varieties and their promotion. ABEI in addition to other mandatory assignments is looking after the new production technologies for oilseed crops. PODB is responsible for the promotional field activities related to oilseeds such as introduction of new varieties and production technologies throughout the country. Oilseed crops are classified into two groups viz., traditional and non traditional crops. Rapeseed/mustard, groundnut, and sesame are the traditional ones while others such as sunflower and canola are the non-traditional oilseeds. Mechanization is one of the important and efficient tools to enhance the crop yield. It also helps to reduce the labour drudgery and ultimately increased farmers' prosperity.

Key Words: Oilseed Crops; Mechanization; Machinery Development; Domestic Production; Traditional; Non-Traditional; Self-Reliance; Pakistan.

INTRODUCTION

Pakistan is facing a severe shortage of edible oil, as its domestic production can only meet 27% of the total edible oil consumption in the country. The total availability of edible oils in 2007-08 was 3.066 million tonnes (mt) (Anonymous, 2008-09). Local production stood at 0.833 mt, which accounted for 27% of the total availability while the remaining 73% was made available through imports. Thus the country has to import edible oil in large quantity involving a large expenditure in foreign exchange to make up the deficit. It is a matter of great concern that efforts made so far to enhance domestic production of edible oils have had little impact.

Major oilseed crops are classified into two groups namely traditional and non-traditional. Cotton, rapeseed/mustard, groundnut and sesame include in traditional oilseeds while sunflower and canola are included in non-traditional oilseeds (Baig and Ali, 1982). Rapeseed/mustard, sunflower and canola are important oilseed crops after cottonseed, which contribute approximately 7%, 32% and 10 % in the total domestic edible oil production, respectively. Cotton is primarily a fiber crop and oil is its by-product while rapeseed/mustard, canola and sunflower are the main oilseed crops. They were grown over 0.576, 0.402 and 1.130 million acres with a total production of 0.172, 0.208 and 0.683 mt, respectively in 2007-08 (Anonymous, 2008-09).

Groundnut was grown over 0.231 million acres with a total production of 0.074 mt in 2006-07 (Anonymous, 2006-07). It is grown as an oilseed crop in the country,

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Table 1. Yield Potential of different Oilseed Crops

Crop	Yield potential	Average yield	Yield gap	Unachieved potential
	----------($kg\ ha^{-1}$)----------			(%)
Rapeseed	3700	839	2861	77.3
Sunflower	4200	1242	2958	70.4
Groundnut	4000	722	3278	82.0
Sesame	1200	448	752	62.7

Source: Anonymous, 1995

but due to its small growing areas in Punjab, Sindh and NWFP, the annual production is not sufficient for oil extraction. The major portion of the produce is consumed in confectionary. The other oilseed crops traditionally grown in the country are castorseed, safflower and linseed. The contribution of these crops in production of domestic edible oils is negligible. The research conducted in the crops indicated that the national yield of oilseed crops is still very low as compared to their yield potential (Table 1). The percent share of major oilseed crops in domestic oil production is given in Figure 1.

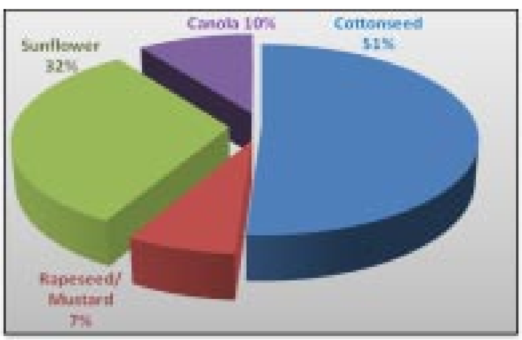

Figure 1. Share of major oilseed crops in domestic edible oil production

CHANGING OILSEED COMPLEX

The oilseeds sector is undergoing significant change. The report of Global Oilseed Complex, Rabobank International Food & Agribusiness Research and Advisory shows that primary production and processing of soybeans is moving from North America to South America, while for other oilseed crops, the focus is swinging from Western Europe to Eastern Europe and Asia. According to Dominy (2004) soy still dominates a global oilseed market that is experiencing geographic shifts in production and processing in response to changing supply and demand patterns.

MECHANIZATION IN NATIONAL PERSPECTIVE

Pakistan food security and surpluses for export at competitive prices require efficient development and utilization of agricultural resources. Costs of production of various crops are not competitive due to low productivity mainly because of inefficient farming practices. Intensive use of agriculture machinery needs to be popularized among farmers to improve the average yield. It may be noted that population density is increasing, land-to-man ratio is deteriorating and food requirement is growing more and more. It is well known that efficient use of agricultural machinery not only speeds up cultivation processes but also accelerates harvesting and threshing operations. It also results in considerable saving of fodder and feed through a reduction in bullock population.

Thus, a transition from subsistence farming to commercial farming can only be achieved through the transfer of the latest, most efficient and cost effective technology to the farming system. The efficient use of scarce agriculture resources and accelerated agriculture mechanization is, therefore, vital and demand comprehensive strategic planning for the future. Considering the role of precision in farm operations, the use of machinery has been encouraged through provision of credit by commercial banks. The demand for tractors has outstripped local production. The current mechanisation status of each oilseed crop is discussed as per different field operations like sowing/planting, harvesting, threshing, combining and post-harvest measures.

Rapeseed/Mustard/Canola

Sowing/Planting

Traditionally, rapeseed crop is sown with broadcast method as no specific sowing machinery is available (Shahid, 2003). The broadcast method is not much encouraging under rainfed conditions due to water scarcity. For helping the dry land agriculture particularly for the promotion of canola type rapeseed/mustard as an oilseed crop for enhancing edible oil production in the country, a multi-crop seed drill was developed with packing wheels and introduced through field demonstrations (Shahid and Chevalier, 1991). Machine performed well over traditional sowing in two ways i) line sowing at proper depth with controlled seed rate for good seed emergence; ii) seed packing into moist soil with press wheels for optimum crop stand. There was 15-20% increase in crop yield due to the use of mechanical sowing methods. The traditional and mechanical sowing methods are elaborated as follows:

Traditional System

Seed is broadcasted over the soil and left without soil coverage.

Figure 2. Rapeseed drill with packing wheels

Shortfalls

- Poor seed emergence due to water scarcity in rainfed areas
- Difficult crop protection and weed control
- Difficult crop harvesting
- Low crop yield

Mechanical System

Sowing with multi-crop seed drill having packing wheels (Figure 2)

Shortfalls

- A few of progressive farmers are using
- Need for improvement in seed covering and furrow opening devices
- Needs commercialization

Future Thrust

Performance evaluation should be done and documented after making necessary modifications if required. Efforts need to be strengthened for its commercial adaptation.

Harvesting and Threshing

Traditionally, harvesting of rapeseed crop is done manually with sickle which is a labour intensive operation. Harvested crop is immediately shifted to the threshing floor and is left there for sun-drying for few days. Then threshed with animal or tractor treading as no proper harvesting and threshing machinery was available in the country. Some efforts have been done during last two decades by different institutions for mechanized rapeseed harvesting and threshing but unfortunately they failed to fulfill farmers' requirements. Different optional solutions for rapeseed harvesting and threshing were tested and evaluated by Farm Machinery Institute (FMI) in collaboration with BARD Project in early 1990's (Anwar et al., 1991).

In recent years, conventional wheat thresher has been modified and evaluated at farmer's field by FMI engineers (Shahid, 2003). Machine performed well. Finally, it was commercialized through local machin-

Figure 3. Traditional rapeseed harvesting

Figure 4. Rapeseed threshing with tractor treading

Figure 5. Manual cleaning after tractor treading

ery manufacturing industry. The manufacturer's machine was evaluated and demonstrated in canola growing areas of Punjab and NWFP in collaboration with Pakistan Oilseed Development Board (PODB). Output capacity of the machine was

Figure 6. Swather under development

Figure 7. Canola thresher in operation

460 kg h^{-1} with threshing efficiency of 98%. The operational and total cost for mechanical threshing was Rs. 1,250 as compared to Rs. 2,800 t^{-1} of output seed for traditional threshing (Shahid et al., 2006). The harvesting and threshing methods are discussed as under:-

Conventional System

Manual cutting followed by manual collection and shifting to threshing floor and then threshing with animal or tractor treading (Figures 3, 4, and 5).

Shortfalls

- Difficult and time consuming
- Labour intensive
- High seed losses
- Low and poor quality output
- High operational cost

Mechanical Systems

There are three options

i) Harvesting with mechanical reaper windrower followed by manual collection and shifting to threshing floor, and then threshing with wheat-cum-canola stationary thresher (Figures 6 and 7)

Shortfalls

The canola swather is under development process. The development process was stopped due to non viability of present design.

Performance Data (Canola Thresher)

- Output Capacity	460 kgh^{-1}
- Seed Losses	< 2 %
- Power Source	min 50 hp Tractor with PTO
- Drum Speed	550 rpm
- Operational cost	Rs. 1,550 t^{-1}

Future Thrust

A three years proposal for development project "Development and Commercialization of Canola Swather" was prepared and submitted to Agriculture Linkages Programme (ALP) for funding. A commercial copy of Wheat-cum-Canola Thresher manufactured by M/s Punjab Engineering Company, Faisalabad, has been evaluated and demonstrated at different locations in Punjab and NWFP (Shahid and Amjad, 2008). The commercialization process needs to be further strengthened.

ii) Harvesting with swather, sun-drying for few days, and then threshing with combine harvester with pickup header

Figure 8. MF8 Combine with pick-up

Figure 10. Direct combining with MF8 Harvester

Figure 9. FMI WCH with pickup header

Figure 11. Direct combining with FMI WC Harvester

(Figures 8 and 9).

Shortfalls

Second-hand combine harvesters already being used for direct combining of wheat crop are without pickup headers.

Future Thrust

Pickup header attachment for ordinary combine harvesters need to be imported; modified if required and tested, then accordingly be made locally and commercialized.

iii) Direct combining with tractor mounted FMI Whole Crop Harvester or ordinary combine harvester (Figures 10 and 11).

Shortfalls

- Maturity time of rapeseed/canola crop is not as uniform as for wheat crop. It varies within same field and field to field. So direct combining in rapeseed/canola is not so easy and viable worldwide due to seed quality deterioration.
- Different chemicals (desiccants) are sprayed on standing canola crop for enhancing uniform maturity before starting direct combining which is expensive and not affordable.

Figure 12. FMI Seed Processing Unit

Figure 13. FMI Mobile Flatbed Dryer

Post Harvest Processing

Seed Cleaning unit has been developed and evaluated successfully. It is being commercialized through local manufacturing industry (Figure 12).

Under ALP Project "Development and Evaluation of a Mobile Flat-bed Dryer for Sunflower and Canola" a Mobile Flat-bed Dryer unit has been developed and being evaluated at farmer's field (Figure 13). The main features of the dryer are:

- Reduces the moisture content of sunflower and canola down to safe storage moisture content (9 to 10 %).
- Reduces the chance of production of aflatoxins in sunflower and canola grains.
- Easily moveable from one farm to another.
- Easy to operate and manufacture locally.
- Burns diesel to produce hot air, which is easily available on farm.

Groundnut

Sowing/Planting

Traditionally, groundnut crop is sown with broadcast method which, in recent years has been replaced with Three Lines Field Cultivator Poura Method. Some joint efforts were made by FMI and BARD Project in the past for development and commercialization of groundnut planting machinery. A seed drill and a NARDI type precision planter were developed and introduced. It was learnt through field survey conducted by FMI that some progressive farmers were using these precision machines for groundnut planting [Shahid, 2004]. The number is not very high. Efforts need to be made for commercial adaptation of mechanized seeding/planting.

Conventional System

Planting with broadcast method

Shortfalls

- Poor plant emergence
- 15 to 20 % less crop yield

Mechanical System

There are three options:

i) Planting with farmers' invented Poura Method with ordinary field cultivator.

Shortfalls

- Unequal plant to plant distance and seed depth
- No seed packing in moist soil and improper seed coverage.
- Results in low crop production

Figure 14. BARD developed precision planter

Figure 15. Manual groundnut digging

ii) Planting with special groundnut seed drill or precision planter (Figure 14)

Shortfalls

Commercialization process needs to be accelerated through local manufacturers.

Preferences

- Controlled plant to plant distance and proper seed depth
- Seed packing in moist soil and proper soil coverage.
- Easy plant protection and inter-cul ture.
- Optimum plant emergence
- Significant increase in crop yield.

Future Thrust

Groundnut special seed drill and precision planter need to be tested and evaluated on farmers' field after making necessary modification if required and then commercial adaptation through local manufacturing industry.

Harvesting and Threshing

The groundnut survey conducted by FMI in 2004 indicated that harvesting and threshing operations stand fully mechanized. Almost all groundnut farmers are using FMI designed digger blade and thresher for harvesting and threshing. Moreover, some progressive farmers are using groundnut digger-cum-inverter for harvesting and combine harvester with pickup header for threshing. Effort should be made for improvement of existing groundnut machinery and then speedup its commercial adaptation (Shahid, 2004).

Conventional System

Manual groundnut digging, pods hand

Figure 16. Digger-inverter in field operation

Figure 17. Groundnut thresher in operation

picking or with stick beating followed by manual cleaning (Figure 15).

Shortfalls

- Time consuming and labour intensive operation
- Poor quality output
- High cost of operation

Mechanical System

Harvesting with groundnut digger or digger inverter followed by manual collection and shifting the harvested to the threshing floor and then threshing with stationary thresher (Figures 16 and 17).

Performance Data (Groundnut Stationery Thresher)

Output Capacity	435 kg h^{-1}
Efficiency	97%
Fuel Consumption	4.5 l h^{-1}
Labour Requirement	11.5 man-hours t^{-1}
Losses	Negligible

Future Thrust

The ordinary groundnut digger is not effective in hard soils. For an alternate solution groundnut digger – inverter

Figure 18. Manual GN shelling

Figure 19. Groundnut hand sheller

should be developed, tested and promoted through local machinery manufacture(s).

Groundnut Shelling

Traditionally, groundnut shelling is done manually as no proper machinery is available commercially. The manual method is a labour intensive and time consuming operation. It was learnt through FMI groundnut survey 2004 that an individual can shell a maximum of 4 kg of groundnut pods daily (Shahid, 2005). Only few progressive farmers are using mechanical sheller for seed preparation. Prevailing shelling systems are discussed as follows:

Traditional System

Groundnut hand shelling with manual labour for seed purposes (Figure 18).

Mechanical Systems

There are two options in this system:

i) Shelling with hand sheller followed by manual cleaning and separation of broken nuts (Figure 19).

Performance Data

Capacity	56 kg h^{-1}
Efficiency	90 %
Labour required	1 person
Operational cost	Rs. 3kg^{-1}
Price	Rs. 3,000

Shortfalls

- High breakage losses
- Machine is not available commercially

Future Thrust

- Performance evaluation of prototype hand sheller has already been completed at farmers' field in BARI, Chakwal. Test report was prepared.
- Efforts will be made for its commercial adaptation through local machinery manufacturing industry.

ii) Shelling with power sheller or sheller-cum-grader

Shortfalls

No précision power sheller or sheller - grader is available commercially.

Future Thrust

A comprehensive comparative study of available designs of groundnut power shellers should be conducted for selecting a suitable and viable machine. Then efforts should be made for commercial adaptation through local machinery manufacturing industry.

Sesame

The sesame is not a priority oilseed crop as its contribution in domestic edible production is less than 1 percent. It is still grown traditionally (Ahmad and Hanif, 1986). It lacks in mechanized crop production technologies so far.

Non-Traditional Oilseeds

Sunflower

Sowing/Planting

Sunflower is an important non-traditional oilseed crop. Its contribution in domestic edible oil production is increasing day by day, which was about 32% in 2007-08 (Anonymous, 2008-09). Traditionally, sunflower is planted with broadcast or Hand Choppa method on ridges. In recent years the trend has been changed. Farmers have switched over to mechanized planting mainly due to high increase in cost of inputs especially cost of hybrid seed.

Conventional System

Sowing with broadcast method and hand choppa method on ridges

Shortfalls

- Low plant emergence
- Invariable seed rate and depth
- Difficult plant protection and interculture
- Low crop production

Mechanical System

Planting with BARD developed planter and/or FMI developed multi-crop precision planter (Figures 14 and 20)

Figure 20. FMI Multi-crop precision planter

Figure 21. Stationary sunflower thresher

Machine Performance

Capacity	0.6 ha h^{-1}
Row-row dist.	45-85cm
Power required	45 hp

Preferences

- Controlled plant to plant and row to row distance.
- Packing and seed coverage with loose soil.
- Optimum plant emergence.
- Time and labour efficient.
- Fertilizer side band placement.
- Easy plant protection and inter-cul ture.
- Significant increase in unit production.

Future Thrust

At present, different seed drills and precision planters are being used by farmers. Possibly a comprehensive study of all available machines should be conducted for selection of most suitable and viable machine. Better machine should be tested at farmers' field after modifying if required. Then accordingly, promotional efforts should be made for its commercial adaptation on large-scale through local machinery manufacturing industry.

Harvesting and Threshing

Traditionally, sunflower harvesting is done manually as no commercial harvester is available, which is time consuming and laborious operation. The harvesting operation is not mechanized. The wheat combine harvesters are used as stationary thresher and sunflower threshers are frequently used for threshing operation.

Conventional System

Manual harvesting followed by sun-drying and manual shifting to threshing floor for threshing

Shortfalls

- Time consuming and labour intensive
- Poor quality output and
- High operational cost

Mechanical System

Manual harvesting, sun-drying, manual shifting to the threshing floor and threshing with thresher (Figure 21)

Performance

Capacity	1.0 th^{-1}
Cleaning Efficiency	97%
Losses	<2%
Operating Units	> 200
Manufacturers	10

Future Thrust

Sunflower harvesting is still not fully mechanized as no specific combine harvester is available so far. It is suggested that a comprehensive field study on "Current mechanization status of sunflower crop" be conducted. Then accordingly, efforts should be made for mechanized crop production of sunflower for enhancing domestic edible oil production.

RECOMMENDATIONS

Following machinery be acquired for evaluation-cum-adaptation

- Swather for canola harvesting
- Pick-up table for available combine harvesters

Promotion campaign of wheat-cum-canola thresher be strengthened for its commercial adaptation

A comparative performance evaluation study of different seed metering mechanisms for sunflower planting be undertaken

A comprehensive field survey should be conducted to assess mechanization status of sunflower as an oilseed crop for enhancing domestic edible oil production in the country.

On the basis of groundnut survey conducted by FMI in 2004, a comparative performance evaluation study of different local available groundnut power shellers and sheller cum grader should be conducted for identification of a suitable and economically viable machine for commercial adaptation through local machinery manufacturing industry.

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