

In Pakistan, Agricultural Mechanization Status and Future Prospects

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Abstract: Agriculture continues to constitute the backbone of Pakistan's economy by contributing 21.4% to national GDP raw material to important industries such as textile and sugar industry. 65% of its population is directly or indirectly involved with agriculture, but still farm productivity is much less as compared to other countries. One the reason for low farm productivity is lack of farm mechanization. Farm mechanization implies the use of mechanical technology in the varied farming operations such as sowing, harvesting, threshing, leveling, watering, spraying, weeding and similar other farm operations. Farm mechanization is viewed as package of technology to ensure timely field operations, increased productivity, reduced crop losses and improved quality of grain or product. So far, Pakistan has only experienced selective farm mechanization as this concept has remained limited to use of tractors only and currently Pakistan's per hectare use of horsepower is 1.50, India's 2.50, China's 3.88 and Japan's 7.0. The number of tractors in 2004 was 401 thousand against the figure of 157 thousand, ten years back in 1994 and tractors of 50 to 85 horse power were available at the price ranging from Rs.619000 to Rs.166000. The number of combine harvester (Wheat + Paddy) was 6000 in 2004 and wheat threshers were 137 thousand in the same year, while the number of tractor mounted sprayers was 40 thousand in 2004. There is a need to adopt locality specific farm mechanization keeping in view the small land holdings and poor economic condition of farmers. Large scale farm mechanization can only be adopted if cooperative farming gains roots in Pakistan.

Key words: Cooperative farming • Farm productivity • Farm machinery • Tube wells • Traditional farming

INTRODUCTION

Agriculture has remained one of the major sectors of P akistan's economy as it contributes 21.4% (major crops 7%, minor crops 2.4%, livestock 11.4%, fishery 0.4% and forestry 0.3%) to national gross domestic product (GDP), while the share of industry is 25.4% and services sector contributes the remaining major chunk of 54.2% [1]. The size of agricultural economy is more than Rs.3000 billion with more than 22 million hectares under the plough. More than two-thirds of Pakistanis live in rural areas (more than 110 million), of which about 65 percent are employed in agriculture (45 percent of total labor force). Pakistan has become the 6th largest population wise country, world's 4th largest cotton and 9th largest wheat producing country. It is

ranked 2nd in buffalo population, 3rd in goat population and 10th in sheep population and 13th in cattle population worldwide [2]. No doubt the industrial sector continues to thrive and its share to national GDP has increased over time but it depends largely on agricultural production. Being an agricultural country, Pakistan's development is mainly dependent on this sector. However, the agriculture production is much smaller in Pakistan than the other countries of the world. Main constraints in increasing agricultural productivity are non-availability of farm machinery to the farmers at right time and at affordable prices. Farm mechanization means the use of machines and technology in the agriculture sector. Farm mechanization implies the use of mechanical technology in the varied farming operations such as sowing, harvesting, threshing, leveling, watering, spraying,

weeding and similar other farm operations. The farm mechanization includes chemical technology (plant protection measures), hydrological technology (tube wells) and mechanical technology which include tractors and tractor driven implements, threshers and bulldozers [3]. Thus the use of tractor, tube wells and plant protection measures are included in the farm mechanization. In the farm mechanization, the use of machinery is greater as compared to the labor. Mechanization is an important ingredient of the strategy to accelerate growth rate in agriculture sector. Farm mechanization is viewed as package of technology to ensure timely field operations, increased productivity, reduced crop losses and improved quality of grain or product. Farm machines have not only increased the mechanical advantage, but also helped to reduce drudgery, while performing the different agricultural operations. The contributions of agricultural mechanization in various stage of crop production can be viewed as saving in seeds (15-20%), saving in fertilizers (15-20%), saving in time (20-30%), reduction in labor (20-30%), increasing in cropping intensity (5-20%) and higher productivity (10-15%) [4, 5]. The other aims of farm mechanization include increasing the productivity of resources particularly of land and labor, to bring more and more area under cultivation, conserve energy and resources, sustaining agricultural production, improving the comfort and safety of farmers and operators, increasing farm profits and margins and to protect environment. One big aspect of mechanization is that it helps in boosting per-acre yield and reduces post-harvest losses. Seed planters of various types and disc plough, together, ensure optimal utility of seeds (thus higher yields of crops) and shelling, husking and processing equipment cut post-harvest losses. Farms productivity in Pakistan is much as compared to other advanced countries due to non-availability of appropriate agricultural machinery and implements at right time, thereby delaying farm operations (particularly at sowing and harvesting of crops); inefficient selection and use of agricultural machinery including implements, usually mismatching to the field application, lack of proper operation and maintenance of agricultural machines by the farmer or operator/driver; low purchasing power of farmers as farm machines are expensive and their use is seasonal with the exception of few implements for land development and seedbed preparation; and poor quality of repairs of tractors and farm implements at local

workshops which are not adequately equipped and the mechanics are not well trained to provide quality services [6]. Agriculture mechanization in Pakistan is limited to tractorization with cultivator only. In Pakistan, due to lack of technology usage in agriculture sector, we face the problem of crops yields gaps. The average yields production in the agriculture sector of Pakistan is far below the level of those countries that use the technology in their agriculture sector. The level of yields of different crops are 50 - 83 % lower than the average of other countries of the world [7, 8]. The use of technology in the agriculture sector and realization of this unachieved potential can provide excellent opportunity in Pakistan in agriculture sector. Mechanization in agriculture has become all the more important with fears looming large about sustainable food security and Pakistan is no exception to it.

This study provides an insight into agricultural mechanization status in Pakistan and its future prospects which has attained increasing importance in the wake of rising population which stresses the need to increase the farm productivity to ensure food security.

Status of Mechanization: The successful development of farm mechanization is determined primarily by the transition process from manual tools through animal-drawn implements and finally to the application of mechanical power technologies, which affect mechanization capacity and time requirement of farm operations. From tractors and front-end loaders to wheat and maize threshers to potato diggers, there is a long list of machines that are produced locally in Pakistan. Refurbishing of old, imported ginning and rice mills is also not uncommon. Hundreds of farm machines and implements are being produced locally. And over past few years, their production has picked up. Some of them are also being exported. But it's difficult to track the trend. Data shows that production of tractors is done in large-scale manufacturing sector. Production of sugarcane machines, wheat threshers and chaff cutters is officially recorded to some extent. However, stats on production and sales of multipurpose threshers, potato diggers, soil levelers, pit diggers, tiller drills, water sprinklers and several other agricultural machines are barely available. Farmers, benefited by higher support prices of key crops in recent years, are believed to have invested a good amount of money in mechanization of their farming activities. But in the absence of stats on a wide range of

products, there is no way to ascertain it. On the other hand, production of tractors, sugarcane machines, wheat thrashers and chaff cutters rather shows an inconsistent growth trend. Pakistan's per hectare use of horsepower is 1.50, India's 2.50, China's 3.88 and Japan's 7.0 whereas sugar cane yield is 40% lower, wheat & cotton yields are 20% lower, non-basmati rice is 40% lower and milk yield per animal is 90% lower against the global benchmark [9- 11]. Pakistan's agriculture sector also faces over 40-80% post- harvest losses, if compared with global standards. There are around 500 small and medium scale agricultural machinery units manufacturing farm implements/ machines for land development, seedbed preparation, seeding/planting, interculture, reapers, wheat thrashers, maize shellers, sprayers and farm trolleys and meeting the country demand. Local farm machinery/implements manufacturing industry has been provided incentives of zero sales tax. The locally manufactured farm machinery/equipments lack standardization and quality. Standardization is required for use of right type material and ensuring inter-changeability of components and thus facilitates easy repair/maintenance of the products. The quality of locally produced farm machines is generally poor because of poor layout of workshops; lack of managerial, engineering and technical manpower; poor designs; improper manufacturing techniques; lack of availability of quality raw material, components such as gears, sprockets etc.; lack of finance and marketing skills; and non-awareness of manufacturers about standards, non-availability of standards in Urdu and their enforcement. Seed and seed-cum fertilizer drills, planters, mechanical rice trans-planters, vertical conveyor reapers and are in use of landlords and other big farmers only. In the recent past, zero-till drill and raise bed planters, laser land leveler, turbo happy seeder have found good acceptance from the small farmers. In recent past, mechanization has spread to small and medium farmers of the country for which financing have been provided by a family member working abroad. The number of cultivators has reached to 369 thousands in 2004 against 146 thousands in 1984 (Fig. 1), while the number of mould board plough was 40 thousand in 2004 and in the same year, the number of disk plough and ridgers were 29 thousand and 70 thousands respectively (Fig. 2). The number of disk harrows and trolley was 23 thousand and 242 thousands respectively in 2004 (Fig. 3). The tube wells number in 2004 was 931 thousand as compared to

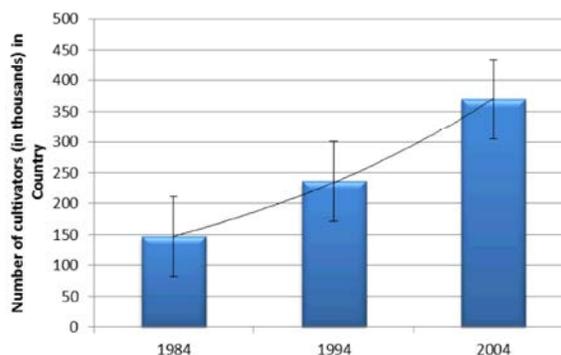


Fig. 1: Number of cultivators (in thousands) in Pakistan

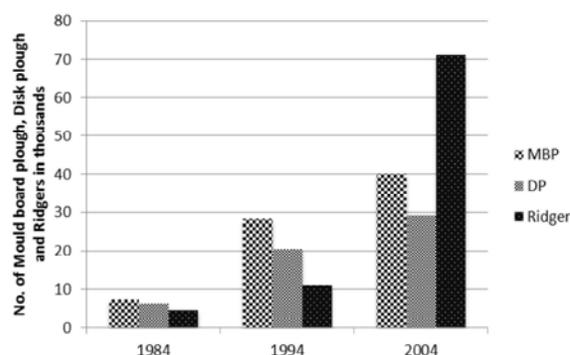


Fig. 2: Number of mould board plough, disk plough and ridgers in thousands in Pakistan

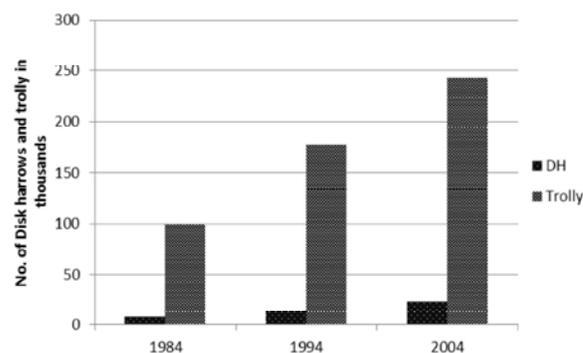


Fig. 3: Number of disk harrows and trolley in thousands in Pakistan

454 thousand in 1994 (Fig. 4). It is also worth mentioning that the number of tractors in 2004 was 401 thousand against the figure of 157 thousand, ten years back in 1994 (Fig. 5). In 2012-13, tractors of 50 to 85 horse power were available at the price ranging from Rs.619000 to Rs.166000 (Table 1) manufactured by Massey Ferguson, Fiat, Belarus, Ford and IMT. According to some privately conducted estimates the number of tractors in operations is around 400,000 resulting in per hectare horse power

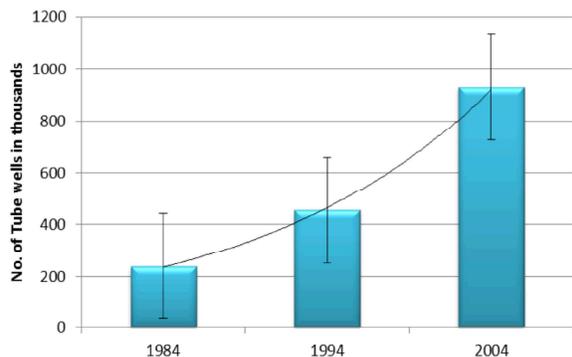


Fig. 4: Number of tube wells in thousands in Pakistan

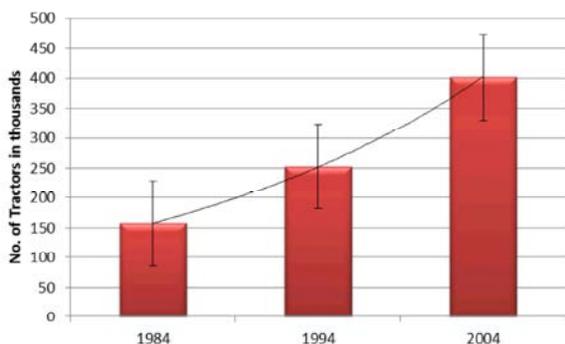


Fig. 5: Number of tractors in thousands in Pakistan

Table 1: Locally made tractor models, their horse power and prices in 2012-13

Tractor Model	Horse Power	Price (Pakistani Rupee)
NH/FIAT- 480S	55 HP	651,200
NH/FIAT- Ghazi S	(65 HP)	737,000
NH/FIAT- Ghazi	(65 HP)	726,000
NH/FIAT- 480 Power	(55 HP)	660,000
NH/FIAT- 640	(75 HP)	940,500
NH/FIAT- 640S DB	(75 HP)	951,500
NH/FIAT- 640 S	(85 HP)	1,034,000
NH/FIAT- 640 S DB	(85 HP)	1,045,000
NH 55-56	(55 HP)	715,000
NH 60-56	(60 HP)	797,500
MF 240	(50 HP)	671,000
MF 260	(60 HP)	737,000
MF 350	(50 HP)	726,000
MF 360	(60 HP)	779,000
MF 385	(85 HP)	1,078,000
MF 375	(75 HP)	968,000
MF 385 (4WD)	(85 HP)	1,660,000
Universal-530	(55HP)	619,400
Universal-530	(55HP)Plus	665,175
Universal-533	(55HP)Plus	665,175
Universal-640	(65HP)	843,150
Universal-683	(83HP)	889,000
Ursus-2812	(50 HP)	6,34,700

(hp) availability of 0.90 against the required power of 1.4 hp per hectare as per FAO [9] recommendations. The number of additional tractors required to achieve this ratio is 185,000. The number of combine harvester (Wheat + Paddy) was 6000 in 2004 and wheat thrashers were 137 thousand in the same year, while the number of tractor mounted sprayers was 40 thousand in 2004.

Future Prospect: Considering the current paradoxical economic situation of the country, particularly the energy crisis, as well as other internal and external challenges, dependency on agricultural sector will further increase to improve the pace of national growth. Therefore, immediate attention is required to accelerate productivity and profitability of this sector both in vertical and horizontal directions. Moreover, urbanization is decreasing the current area under cultivation and water scarcity does not allow bringing new lands under cultivation from the available cultivable waste (8.31 million hectares). As per the economic survey 2012-13, the current area under cultivation is 22.04 million hectares as against 22.27 million hectares in 2002-03. To meet these challenges Pakistan would have to adopt latest technologies; increased availability and efficient use of biological, chemical and hydrological inputs; whereas the role of mechanization would be pivotal in all farm operations starting from field preparation to crop harvesting and storage. In this respect, the role of the local tractor industry needs review by all stakeholders, particularly by the government, to further amplify its role. So far, the industry performance has been quite satisfactory as it is the only agriculture input, wherein the country is not only self-sufficient but due to its global competitiveness in quality and prices, it is also earning foreign exchange through export of tractors and spares parts. The industry has increased its production capacity to about 70,000 units per annum and offers a wide range of models from 50-85 hp to cover the entire spectrum of local customers as per their need and affordability. Presently, tractors being produced in Pakistan are the cheapest in the world (Pakistan \$130 per HP, India \$200 per HP, China \$150 and Japan \$900 Per HP) and 90% self-reliance in production of indigenous built tractors has been achieved over a period of five decades. The tractor manufacturers played a pivotal role in the transfer of technology and transformation of the fledging local light engineering sector into a robust, vibrant, quality conscious auto vending industry, which comprises more than 350 units. These vendors besides being helpful to the local tractor industry are also vital to the entire automobile sector and even to the defense

industry of Pakistan. The industry and associated vendors are also supporting the national economy by paying taxes and duties to the tune of PKR 4.5 billion per annum, exporting tractors, implements and spares worth USD 100 million and providing job opportunities for 500,000 people. The tractor industry in Pakistan does not enjoy any tariff protection as tractors can be imported at zero taxes/duties. Despite this, the imported tractors are unable to match the quality, price and after sales service and facilities offered by local tractor industry to its clients. Tractor importers have, therefore, not been able to achieve any success or provide better options. Currently the impact of 10% GST translates into an increase in tractor prices from PKR 60,000 to PKR 100,000 which has significantly hampered the farm mechanization and dropped the production of tractors and farm machinery. Pakistan food security and surpluses for export at competitive prices require efficient development and utilization of agricultural resources. Costs of production various crops are not competitive due to low productivity mainly because of inefficient farming practices. Intensive use of agriculture machinery needs to be popularized farmers to improve the 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 [12- 15]. 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. There is no exclusive policy package for tractor industry. There is dire need of improved supply of electricity, some tax incentives and cooperation from government agencies to help consolidate this sector. The use of solar technology is catching up among growers across the country and solar-powered tube wells and electricity-generating panels have been a great relief in recent years for a number of progressive farmers. Faisalabad's Agriculture University is trying to develop solar-powered machine for drying of crops, distillation of essential oils and roasting of nuts.

So, a craving for mechanization on modern lines is there, but a policy push is needed to capitalize on it. Unfortunately, though, in our context mechanization concept does not go beyond the use of tractors. The machine, tools and automation exhibition held every year and agriculture, food and livestock fairs have increased awareness about benefits of mechanization of farming activities. But now they also provide local manufacturers a fair chance of marketing agricultural machinery and implements. Sadly, none of these activities are properly documented. Organizers of such events boast of big on-spot sales of machinery and implements. But they don't bifurcate sales of foreign and local exhibitors. Nor do they inform which kinds of machines were sold out, on-spot or through contracts. Pakistan spends about \$100 million annually on import of agricultural machinery and implements. Officials of institutions like Engineering Development Board and Pakistan Agricultural Research Council believe net imports can be reduced with a little effort to boost local production. We need to have an umbrella body to coordinate all efforts on this front, a policy framework and manufacturing SMEs must be taken on board. Firstly, funding should be made for both on-going and new projects. In the first place, ongoing projects include improving conventional farming practices through provision of farm machinery to farmers/service providers, promotion of paddy harvesters and dryers for saving post-harvest losses under public private and accelerated agricultural mechanization through provision of tractors to farmers. Secondly, capacity building is of no less importance. There is need to impart formal training of operation of farm machines particularly on their proper use, maintenance and safety aspects be made obligatory through training schools/centers established both in public and private sector and they should impart training on self-finance basis. Thirdly, institution building should serve as one of the founding stones in the proper farm mechanization. For this, it is a must to establish center of excellence in the country. This center may be located at a central place with sub-offices in all the four provinces. The center apart from testing of local and imported farm machines and issuing test reports (mandatory at least for public sector purchase) should also interact with farmers, manufacturers, credit lending agencies and traders and provide them information/advise on efficient utilization of farm machinery. In the similar fashion, institution building also requires the up gradation/ strengthening of already existed tractor operators' training schools. Fourthly, financial and technical support has also its fundamental role to play in the uplift of mechanization in the farming

sector. In this regard, it is suggested that local manufacturing facilities be upgraded. In general, factors that will influence a farmer's ability and willingness to adopt agricultural technologies involve both farm-specific aspects (i.e. the characteristics of the farmers and the resources at their disposal) and circumstances related to the biophysical and socio-economic context of the farming operation. Technologies may at times be rejected not because of their intrinsic qualities, but rather because they are not compatible with these factors. So, the basic need is that to adopt the science and technology in the field agriculture. Present status of the agriculture is very poor because rural poverty is increase very rapidly speed. This ratio of rural poverty was at 20% in 1990, before this, this ration was very less, but in 2010, this ratio increased at the rate of 60%, so agronomics which is a branch of economics that specifically deal with land usage must be given intention as it focuses on maximizing the crop yield while maintaining a good soil ecosystem. Throughout the 20th century the discipline expanded and the current scope of the discipline is much broader. The introduction of cooperative farming linked with marketing has never been in the light of cooperative principles resulting minimizing the possibility of pooling resources for joint investment for further production. In the context of the FAO indicative world plan suggesting that all developing economics like Pakistan should contrive to achieve a minimum desirable level of 0.2 H.P. per cultivated acre (0.47) hectare as against nearly 0.1 H.P. Farm mechanization is an important factor in agricultural development. Increased production can result from new techniques put into practice on farm. Thus the modernization of our agriculture cannot take place without the transfer of technology aspect. Empirical evidence suggests that an increase in the quality of physical inputs based on traditional cum intermediate technology largely accounts for less than half of the increase in farm output; the remainder occurs as a result of the use of efficient innovative devices [16, 17]. However, there is need for implementing such a dispassionate strategy that suit to our local conditions without which any gainful result can be conceived as has happened in the past. We need to acknowledge the fact that farm mechanization prospects are different in Pakistan as compared to other advanced countries due small land holdings and economic condition of farmers. The need of hour is to develop locality specific measures such as in areas where land leveling is required on large scale, the use of bulldozers and laser land levelers is must and in other areas, productivity can be increased by using traditional methods such as proper

seed bed preparation, using seed of high yielding varieties. Proper irrigation and fertilization, similarly where canal water is not available, those areas must be given priority to install tube wells at subsidized rate and for this solar tube wells are a good choice. It is thus recognized that real economic development cannot be assured without the modernization of agriculture and that this process can be broad based only if high emphasis is given towards transfer of efficient technology that help in bringing reduction in social costs and increasing yield and income in relative terms. This alone can help in alleviating poverty ensuring unemployment and underemployment the menace that our nation faces today. For increasing productivity and sustainability at reduced unit cost of production, free of arduous labor, agricultural mechanization is essential. It is brought in center stage with globalization of world markets. Shifts in agriculture leading to crop diversification towards horticulture, animal husbandry, fishery and forestry are going to bring in greater degree of mechanization.

CONCLUSION

Locality specific farm mechanization needs to be adopted such as in areas where land leveling is required on large scale, use of bulldozers and laser land levelers is must and in other areas, productivity can be increased by using traditional methods such as proper seed bed preparation, using seed of high yielding varieties. Proper irrigation and fertilization, similarly where canal water is not available, those areas must be given priority to install tube wells at subsidized rate and for this solar tube wells are a good choice. Cooperative farming, while maintaining individual ownership is an option to make farm mechanization widespread. The government has the greater responsibility to share as it can only provide farm machinery on subsidized rent and rate to farmers.

REFERENCES

1. Economic Survey of Pakistan, 2013. Govt. of Pakistan, Ministry of Food, Agric. and Livestock Div. Economic Wing, Islamabad.
2. FAO. Food and Agricultural Organization. 2009. Rome, Italy.
3. Naresh, R.K., P. Satya and S. Madhvendra, 2012. Role of conservation agriculture and agricultural mechanization on productivity, sustainability and income generation in North West India. *Int. J. Agric. Eng.*, 5(1): 103-113.

4. Singh, G., 2006. Estimation of a mechanization index and its impact on production and economic factors - A case study in India. *Biosys. Eng.*, 93(1): 99-106.
5. Chauhan, N.S., P.K.J. Mohapatra and K.P. Pandey, 2006. Improving energy productivity in paddy production through benchmarking—an application of data envelopment analysis. *Energy Conv. Manag.*, 47: 1063-1085.
6. Devendra, C.B. and C.B. Ganesh, 2008. Energy demand forecast for mechanized agriculture in rural India. *Energy Policy*, 36: 2628- 2636.
7. Tewari, V.K., A.A. Kumar, S.P. Kumar and B. Nare, 2012. Farm mechanization status of West Bengal in India. *Basic Res. J. Agric. Sci. Rev.*, 1(6): 139-146.
8. Khan, M.A.J., T.E. Lodhi, M. Idrees, Z. Mahmood and S. Munir, 2011. Training needs of agricultural officers regarding mechanized farming in Punjab, Pakistan. *Sarhad J. Agric.*, 27(4): 133-137.
9. FAO. Food and Agricultural Organization. 2004. *Production Yearbook 2003*, Rome, Italy.
10. Punjab development statistics, 2013. Govt. of Punjab, Pakistan. Annual Reports. pp: 80-140.
11. Agricultural statistics of Pakistan, 2011. Govt. of Pakistan.
12. Rahman, M.S., M.A.M. Miah, M. Zaman and S. Hossain, 2011. Impact of farm mechanization on labour use for wheat cultivation in northern Bangladesh. *J. Anim. Plant Sci.*, 21(3): 589-594.
13. Nayak, V.K., K.N. Yadaw and M.K. Jhariya, 2012. Status of farm mechanization in Durg district of Chhattisgarh. *Int. J. Agric. Eng.*, 5(2): 288-291.
14. Reddy, T.Y. and G.H.S. Reddy, 1992. *Principles of agronomy*. Kalyani publishers, New Dalhi, India.
15. Tilman, D., C. Balzer, J. Hill and B.L. Befort, 2011. Global food demand and the sustainable intensification of agriculture *Proc. Natl. Acad. Sci. USA.*, 108: 20260-20264.
16. Zhang, F., X. Chen and P. Vitousek, 2013. Chinese agriculture: an experiment for the world. *Nature*. 497: 33-35.
17. Abbas, M.A., 2013. *General agriculture*. Publisher Emporium, Lahore, Pakistan.