Short Communication
Studying the impact of farm mechanization on wheat production in Punjab-Pakistan

Muhammad Yamin[1], Abdul Rehman Tahir (Late) [1], Abdul Nasir [2] and Muhammad Yaseen [3]
[1]Department of Farm Machinery and Power, University of Agriculture, Faisalabad
[2]Department of Structures and Environmental Engineering, University of Agriculture, Faisalabad
[3]Lecturer, Department of Mathematics and Statistics, University of Agriculture, Faisalabad

Abstract

Contribution of mechanical inputs in farming is considered in terms of farm mechanization. Farm mechanization has helped in increasing the cultivated area and yield of major crops like wheat, rice and maize to 0.4%, 10.4% and 27.3%, respectively, by bringing barren land under cultivation. To study the present status of farm mechanization in all the districts of Punjab using GIS, data of farm machines, sowing area and wheat crop production was collected from Census Organizations for 1994-95 to 2004-05. Graduated color maps and multivariate maps were used to analyze the spatial variation in farm mechanization in thirty four districts of Punjab upto year 2004. To analyze the combined effect of most common farm machines (tractors, disc plows, cultivators, tubewells and threshers) on cultivated area of wheat and its production, multivariate maps help by considering the sum attribute of these farm machines. According to maps generated; Central, Southern and Eastern Punjab have greater area under cultivation as compared to Northern Punjab except Attock and Mianwali and there is a great need of recommended farm machines which may help to increase the wheat production for the same area under cultivation.

Keywords: Farm mechanization, wheat crop, GIS, Pakistan, Punjab, district

Agricultural productivity depends upon biological, hydrological, chemical and mechanical inputs. Contribution of mechanical inputs in farming is considered in terms of farm mechanization. To optimize the use of biological, hydrological and chemical inputs, farm mechanization plays a pivotal role.

In Pakistan, farm mechanization started in early fifties to operate private tubewells for irrigation purposes with the help of mechanical power. At the time of creation of Pakistan, there were about 500 tractors in the West Pakistan (Ansari and Raza., 1984). According to the machinery survey conducted in 2004, there are 4,25,000 tractors in Pakistan along with a huge increase of 31 times in tubewells and 22.5 times in thresher (GOP, 2005). Other farm machinery has also exceeded in considerable numbers.

Initially, a large number of farmers were hesitant to adopt the farm machinery due to their illiteracy and rigidity for the use of conventional methods. But with the passage of time, farm mechanization proved to be beneficial in increasing agricultural productivity by saving time, water and other agricultural resources.

A farm mechanization committee was established by the Government of Pakistan in 1968 to assess the available power at farm which was around 0.1 horse power per hectare against the recommended power of 1.1 hp ha^{-1} for optimum mechanization in developing countries (Khan and Amjad, 2006).

In Pakistan, selective farm mechanization is being practiced and only those farm operations and activities have been mechanized for which there were constraints of labor or power or combination of both. However, slow and selective farm mechanization not only increased farm income and labor productivity but also generated off-farm employment in manufacturing, supply of agricultural inputs and post harvest handling of increased agricultural production. Also the introduction of improved crop varieties and the modification of tillage practices have been identified as potential on-farm practices that could increase the agricultural productivity (Khan *et al.*, 1995)

In this context, farm mechanization has helped in increasing the cultivated area and yield of major crops like wheat, rice and maize to 0.4%, 10.4% and 27.3%, respectively, by bringing barren land under cultivation (GOP, 2006). Pakistan has a very rapidly increasing population of about 166.5 million (GOP, 2010). The present growth rate of 1.65% shows that the population of Pakistan

*Email: yamin529@uaf.edu.pk

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will be 180 million by the year 2015. This is becoming an alarming situation in relation to the country's food producing potential.

Therefore, the expectations of a wide gap between future food requirements and supplies are high. This gap may be reduced by improving average yields with the help of suitable farm machinery, introducing new varieties of crops, potential irrigation methods, new sowing techniques and application of new fertilizing techniques by applying the combination of FYM and inorganic fertilizers (Mehdi *et al.,* 2011).

Successful implementation of farm mechanization requires an effort by policy makers, institutions and extension workers to train and educate the farmers and then introduce new mechanical techniques, modify, expand and adapt existing ones. This will be possible when farm mechanization status in the country is critically reviewed. For this purpose, GIS (Geographic Information System) database of farm mechanization may be developed. GIS technology integrates common database operations such as query and statistical analysis with the unique visualization and geographic analysis benefits offered by maps (Fotheringham and Rogerson, 1993).

In the light of proceeding facts a GIS database was developed to study the status of farm mechanization spatially and temporally in Punjab during 1975-2004.

To study the farm mechanization status in all the districts of Punjab using GIS, data of farm machines, sowing area and wheat crop production was collected from Census Organizations for 1994-95 to 2004-05. For digitizing and georeferencing the scanned map of Punjab, it was imported in AutoCAD 2002 with an insertion point of definite coordinates of WGS-1984. In AutoCAD, boundary of every district of Punjab was digitized by using "line" tool. Digitized file was saved in "dxf" format which is importable in ArcGIS v9.0. In "dxf" format, the digitized map is saved only in vector form. In ArcGIS v9.0, the digitized map was imported and its line features were converted to thirty four different polygons representing all the 34 districts of Punjab.

Respective data was linked with the digitized map of Punjab having 34 polygons representing each district. To analyze the spatial variation in farm mechanization in thirty four districts, graduated color maps and multivariate maps were used.

Farm mechanization has helped in increasing the cultivated area and yield of major crops like wheat, rice and maize to 0.4%, 10.4% and 27.3%, respectively, by bringing barren land under cultivation (GOP, 2006).

Figure 1 shows that the increment of area under wheat crop in the Punjab follows a straight line. It means that the area under cultivation is increasing almost at a constant rate but on the other hand wheat production doesn't follow the straight line. It is in fluctuating condition from 1995-96 to 2004-05. It appears that during 2000-01 and 2004-05 wheat production has a sudden and greater change. It means that for these durations, the factors like soil fertility, wheat variety, available water and especially the farm mechanization are contributing more than increasing area under cultivation.
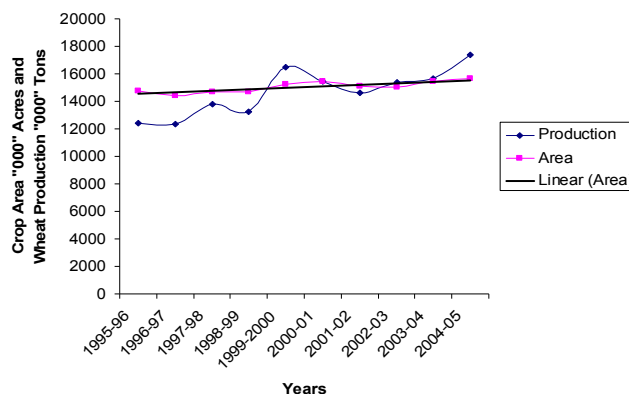

Figure 1: Trend of wheat production and area under wheat cultivation in Punjab from 1995-96 to 2004-05

Figure 2 generalizes the results more clearly in the sense that farm machines are going to be increased gradually but wheat production has not a good slope comparatively due to less area increment of 0.4% as shown in Figure 1.
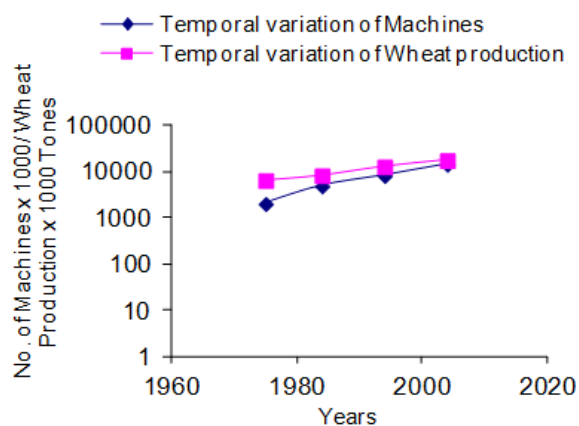

Figure 2: Trend of farm machines and wheat production

To analyze the combined effect of most common farm machines (tractors, disc plows, cultivators, tubewells and threshers) on cultivated area of wheat and its production, multivariate maps help by considering the sum attribute of these farm machines. Figure 3 shows that the contribution of farm machinery on wheat production is greater as compared to the cultivated area of wheat. It means that for year 2004-05, area should be increased with the increase in farm machines to get higher production as compared to previous years.
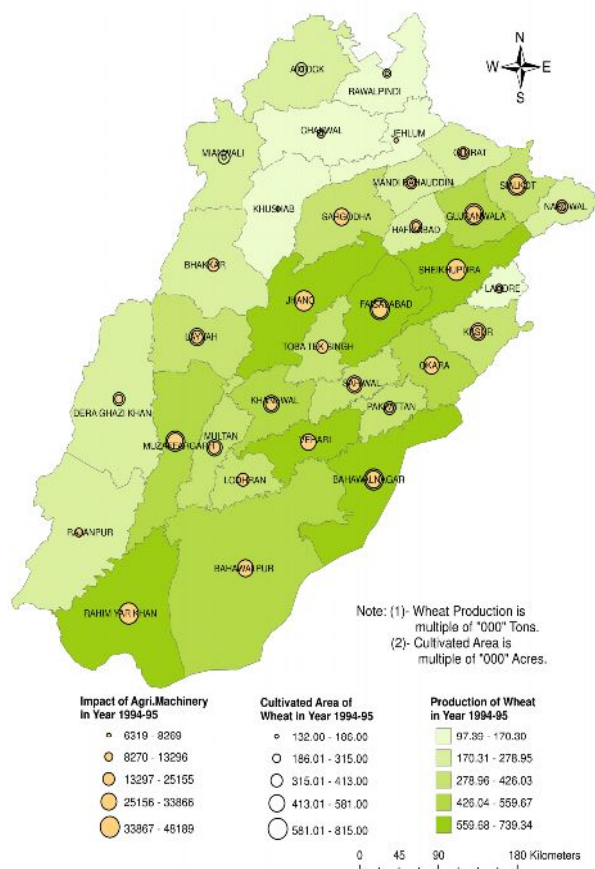
recommended farm machines which may help to increase the wheat production for the same area under cultivation.

Recommendation

✓ A federally administered fully computerized database should be developed to understand the farm mechanization situation in a better way. It will help the policy makers and planners in better policy making.
✓ Machinery manufacturing companies in Punjab should be encouraged to diversify their output by producing small and medium size farm machines to fulfill mechanization requirements especially in Western Punjab (D.G Khan, Muzaffargarh, Lodhran, Multan, etc.)
✓ With reference to the Figure 4, insufficient number of recommended farm machines for wheat crop is present in different districts of the Punjab having larger areas under cultivation. This reveals that there is a good scope of increment in production in those areas by increasing and managing agricultural machines .e.g. D.G. Khan, Multan, Bahawalpur, Lodhran, Pakpattan, Chalwal, Faisalabad, etc.
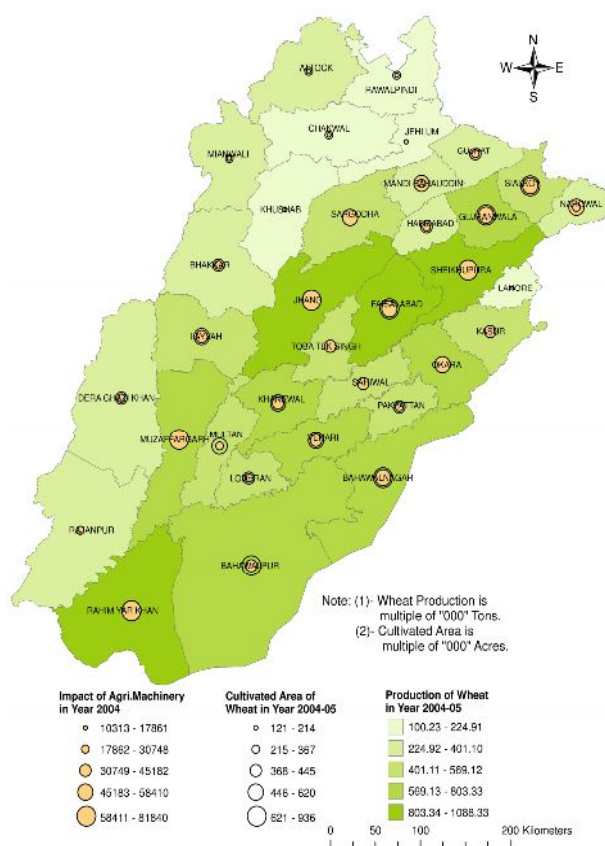

Figure 3: Impact of farm mechanization on cultivated area and wheat production in 1994-1995

This statement seems to be true in Figure 4 for 2004-05. The graph legends showing the impacts of agricultural machinery in 1994-95 and 2004 reveal that the overall impact of most common farm machines on wheat production is greater in all zones of the Punjab except in Northern Punjab where stony and hard soil exists.

On the same spatial pattern Central, Southern and Eastern Punjab have greater area under cultivation as compared to Northern Punjab except Attock and Mianwali. According to Figure 4, there is a great need of

Figure 4: Impact of farm mechanization on cultivated area and wheat production in 2004-2005

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