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Article

Comparing Costs and Profitability of Canola, Rapeseed-Mustard, and Wheat Production in Punjab: Lessons for Integrating Oilseeds in Cropping Pattern

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ABSTRACT

The profitability analysis for rapeseed-mustard and canola revealed that land rent, fertilizer, harvesting, threshing, and ploughing were major cost items. The total per-acre cost of production, gross income, net profit, and Benefit-Cost Ratio (BCR) for rapeseed-mustard were PKR 63413, PKR 105572, PKR 42159, and 1.66, respectively. For canola, the total cost of production per acre, gross income, net profit, and Benefit-Cost Ratio (BCR) were PKR 65765, PKR 134933, PKR 64225, and 2.05, respectively. The total cost of production per acre, gross income, net return, and Benefit-Cost Ratio (BCR) for wheat were PKR 79073, PKR 105785, PKR 11479, and 1.33, respectively. This profitability analysis revealed that the total per-acre cost of production for rapeseed-mustard and canola is lower than that of wheat. On the other hand, net profit and BCR for rapeseed-mustard and canola are much higher than for wheat, indicating that these oilseed crops are more profitable. However, their cultivation is not gaining the desired momentum in Punjab. Wheat being the staple diet, with support prices and procurement policies, thus blocking the adoption of oilseed crops. Lack of consistency and flaws in government policies are clearly evident in the case of oilseed crops. Policy makers must exercise due care while devising policies for the competing crops.

Keywords: *Oilseeds Crops; Cost and Profitability Analysis; Comparative Crop Analysis; Diverse Cropping Pattern; Pakistan*

1. Introduction

The development of food and agriculture has been and remains the top agenda in the global economic order to ensure food security, sustainable agriculture, and economic growth (FAO, 2021), as hunger killed more people than all wars combined. The provision of food, clothing, and shelter is a basic necessity of life, and their denial leads to death (FAO, 2023). Wheat and oilseed consumers depend on their imports from Russia and Ukraine. The World Food Program (WFP) for wheat also heavily depends on Ukraine's food production (FAO, 2022). Because of the Russia-Ukraine war, the FAO Food Price Index (FFPI) reached its highest level since the 1990s, at 159.7 points. It was 30 percent higher than its last year's value. This price hike affected the vulnerable people in low-income food-deficient countries (FAO, 2022). In 153 food-deficient countries, 193 million people are food-insecure because population growth exceeds food production growth (GRFC, 2022). Climate change and water availability are interconnected; a slight change in either leads to significant changes in crop and livestock productivity, and hence food security (Mehraj et al., 2023). Climate change will cause crop yield losses of 5 to 30 per cent in Asia alone by 2050 (IPCC, 2022). The disastrous floods of 2022 and 2025 in Pakistan are an indication of this phenomenon. The 2022 floods caused damage of PKR 3.2 trillion to the Pakistan economy and PKR 800 billion to the agriculture sector. As a result of these damages, total food imports into Pakistan exceeded 10 billion PKR (GOP, 2023). Pakistan's healthy economic growth rate of 6.1 per cent in 2022 declined to 0.3 per cent, mainly due to climate change and relentless shocks in the global and Pakistani economies (GOP, 2023 Rapid urbanization and a rapidly growing population are

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reducing per capita availability of land and water in Pakistan, thereby increasing pressure on shrinking land and water resources to meet the country's food demand (Rehman et al., 2021; Yaqoob et al., 2022; and Farah et al., 2022). Declining resource availability requires sustainable and efficient agricultural practices to ensure food security and reduce the country's food import bill (Raza et al., 2020). Sustainable agricultural growth is a precondition for the country's food security and development (Rehman et al., 2015). More than 90 per cent of farmers in Pakistan are smallholders with less than 5 hectares of land. These small farmers are cash-strapped and resource-scarce, and they need short-duration, high-value, and more profitable crops. Vegetables and oilseed possess such an advantage (Adil et al., 2007). Cost of production is one of the fundamental pieces of information needed by both farmers and policymakers for the sustainable growth and development of the agricultural sector. Cost of production and profitability are the most fundamental and critical information required by the farmer for decision-making about what to produce. How to produce? Moreover, how much to produce? (Kebede and Gan, 1999 and Adil et al., 2007)

2. Materials and Method

2.1. Sampling and Study Area

Estimating production costs and profitability is a challenging task. Various methodologies exist to estimate production costs and profitability. One methodology identifies the fixed and variable cost components of each activity – this is very complex and requires much more data. The other methodology identifies the cultural operations and all crop-related activities performed, their numbers, and multiplies each operation/activity by its prevailing market rate. Total revenue is then calculated by multiplying the canola yield by the market price and adding the value of the product. This approach was proposed by Ahmed et al. (2004, 2005) is used in this study. The crop reporting services in Punjab, Pakistan, use the same methodology. This approach is widely adopted in the context of Pakistan due to its flexibility in adjusting to the nature of operations and variation in units. In addition, each minor as well as major operations are accounted for under this approach

The cost of production and profitability of rapeseed-mustard, canola, and wheat crops were estimated using data collected from 479 farmers in the Sargodha and Faisalabad divisions for the crop year 2022-23. To estimate the total cost, the following formula was used.

$$TC = V_1X_1 + V_2X_2 + \ldots\ldots + VnXn \ldots\ldots (1)$$

Where, TC is total cost, V_1, V_2, ... Vn, are the prices of inputs and X_1, X_2, … Xn are the quantities of input used per acre in crop production.

The Gross income from crop production is estimated by multiplying the crop output by its market prices plus the value of the by-product. In the form of an equation, it can be written as,

Gross income (GI) or Total Revenue P_1Y_1+ value of by-product

Where P_1 is the price of rapeseed-mustard/canola and Y_1 is the output of rapeseed-mustard

Following Debertin (2012), the net profit was calculated as

Profit Total Revenue (TR) - Total Cost (TC).. (3)

The Benefit-Cost Ratio (BCR) is also used to assess the profitability of a crop and is calculated by the formula (Broadman *et al.,* 2018),

$$BCR = TR/TC \ldots\ldots\ldots\ldots (4)$$

- BCR > 1: benefits outweigh costs, means crop is profitable
- BCR = 1: Benefits equal costs.
- BCR < 1: costs outweigh benefits, means crop is not profitable

3. Results and discussion

The estimated production and profitability costs for rapeseed-mustard are presented in Table 1. The major cost items were land rent, fertilizer, harvesting, irrigation and ploughing. The total cost of production, gross income, net profit, and Benefit-Cost Ratio (BCR) for rapeseed-mustard were PKR 63413, PKR 105572, PKR 42159, and 1.66, respectively. The net profit and Benefit Cost Ratio (BCR) of the study are in line with those of Ali *et al*. (2022), Abbas *et al.* (2010), Omonona *et al.* (2010), Avval *et al.* (2011), Islam *et al.* (2011), Reyhan *et al.* (2013), Dhakal *et al.* (2015), Jaffar *et al.* (2016), Dutta (2016), Sampa *et al.* (2020), Wambui and Eucabeth (2020) and Sarkar *et al.* (2020).

Table 1: Cost of Production of Rapeseed Mustard

Inputs	Cost/Unit (PKR)	No. of Operations	Cost/acre (PKR)
Land preparation			
Deep ploughing	2781	0.37	1029.09
Ploughing	1511	2.13	3218.5
Laser land leveling	3180	0.31	985.8
Seed rate (Kg/Acre)	734	2.26	1658.84
Sowing cost			260
Fertilizer cost			
Inputs	Cost/bag (PKR)	Bags/acre	Cost/acre (PKR)
Urea	2375.82	1.05	2494.62
DAP	12591.08	0.91	11457.9
Other Fertilizers	3155.87	0.49	1546.38
Irrigation Cost			3300
Intercultural and Plant Protection Measures			
Inputs	Cost/Unit (PKR)	No. of Operations	Cost/acre (PKR)
Weedicide	648.45	0.83	538.21
Pesticide	467.60	0.53	247.82
Labour			520
Harvesting and Threshing Cost			
Inputs	Cost/Unit (PKR)	No. of Operations	Cost/acre (PKR)
Harvesting cost	3646	1	3646
Threshing cost	6010	1	6010
Land Rent			25000
Transportation+ Bardana (bags)			1500
Total cost			63413.16
Gross Income	Price/40 Kg (PKR)	Yield Mounds/acre	Income (PKR/acre)
	5340	19.77	105571.8
Income from byproduct			4943
Total			110514.8
Net Income/Profit			42158.64
Benefit Cost Ratio (BCR)			1.66

The cost of production and profitability analysis of the canola crop is presented in Table 2. The major cost items were land rent, harvesting and threshing costs, and fertilizer and ploughing costs. The total per acre cost incurred on Canola was PKR 65765. The gross income from canola was PKR 134933. The difference between the gross income and total cost was PKR 64225 per acre. The Benefit Cost Ratio (BCR) for canola was 1.98. The positive net profit and Benefit Cost Ratio (BCR) of the study are in line with those of Ali *et al.* (2022) Abbas *et al*. (2010), Omonona *et al.* (2010), Avval *et al.* (2011), Islam *et al.* (2011), Reyhan *et al.* (2013), Dhakal *et al.* (2015), Jaffar *et al.* (2016), Dutta (2016), Sampa *et al.* (2020), Wambui and Eucabeth (2020) and Sarkar *et al.* (2020). Wheat, being the staple food of human beings and for animals, is the major Rabi crop of Pakistan. It is also the dominant crop of the Rabi season in Punjab, Pakistan, and a main competitor to Canola. The per-acre cost of production of wheat is presented in Table 3. The major cost items were land rent, harvesting and threshing, fertilizer and ploughing. The total cost of wheat per acre was

Table 2: Cost of Production of Canola

Inputs	Cost/Unit (PKR)	No. of Operations	Cost/acre (PKR)
Land Preparation			
Deep ploughing	2781.34	0.41	1140.35
Ploughing	1511	2.11	3188.21
Laser land leveling	3180	.81	2575.8
Seed rate	734	2.01	1475.34
Sowing cost			260
Fertilizer Cost			
Inputs	Cost/bags (PKR)	Unit/acre	Cost/acre (PKR)
Urea	2447.68	1.067	2611.68
DAP	12453.86	1.014	12628.21
Other fertilizers	3004.59	.271	814.25
Irrigation cost			3700
Intercultural and Plant Protection Measures			
Inputs	Cost/unit (PKR)	No. of Operations	Cost/acre (PKR)
Weedicide	648.45	0.64	415.008
Pesticides	467.60	0.43	201.07
Labour			520
Harvesting and Threshing Cost			
Inputs	Cost/unit (PKR)	No. of Operations	Cost/Acre (PKR)
Harvesting cost	3700	1.0	3700
Threshing cost	6035	1.0	6035
Land Rent			25000
Transportation+ Bardana (bags)			1500
Total cost			65764.91
Gross Income	Price/40 Kg (PKR)	Yield Mounds/acre	Income (Rs/acre)
	6190	21.0	129990
Income from by-product			4943
Total			134933
Net Income/profit			64225.09
Benefit Cost Ratio (BCR)			1.98

PKR 79073. The gross income generated from one acre was PKR 105785. The net profit per acre was Rs 11479, and the Benefit Cost Ratio (BCR) for wheat was calculated as 1.14.

The net profit from rapeseed-mustard and Canola is much higher than that of the wheat crop. To support the result, i.e. Canola and rapeseed are more profitable than wheat, the cost of production, gross income, and net profit estimated for Canola, rapeseed-mustard, and wheat for the year 2020-21 to 2023-24 by the crop reporting department, government of Punjab, are also presented below in Tables 4, 5, and 6. According to the crop reporting survey, wheat is more profitable than rapeseed-mustard and Canola for the year 2023-24 because wheat gross income was estimated at PKR 4100/40kg, which is almost double that of the market prices of the subsequent year, which varies between PKR 2000 to PKR 2200/40kg. Still, canola is grown on much lower acreage than the wheat crop. Because of this, Pakistan has to import 85% of its edible oil requirements. The main reason is that wheat production ensures the country's food security, is a more stable crop in terms of yield and output prices (supported by the government's support price and procurement), is free from the risk of pests and diseases, and fits well with Pakistan's cropping patterns. Whereas Canola and mustard are more prone to pests, diseases, and other risks. Other reasons are a lack of consistency and flaws in government oilseed

policies. Periodic announcement of a subsidy of PKR 5000/acre and its denial to many farmers; support price of PKR 2500/40kg in the absence of procurement programs and their enforcement; and the lack/non-availability of production machinery are the perfect examples. Abolishing wheat support price and procurement on the one hand, and announcing a PKR 5000/acre subsidy for wheat growers in Punjab, are other examples.

The inconsistent implementation of oilseed policies, such as irregular subsidies and the absence of effective procurement, further discourages large-scale adoption of canola and mustard (Ahmad & Khan, 2023). Consequently, Pakistan remains dependent on edible oil imports despite the comparative profitability of domestic oilseeds (GoP, 2023).

Table 3: Cost of Production Wheat

Inputs	Cost/Unit (PKR)	No. of Operations	Cost/acre (PKR)
Land preparation			
Deep ploughing	3145.39	1.20	3774.47
Ploughing	1511	1.57	2372.27
Laser land leveling	2130.63	1.16	2471.54
Seed rate Kg/acre)	76	48.53	3688.28
Sowing cost			375
Fertilizer Cost			
Inputs	Cost/bag (PKR)	Unit/acre	Cost/acre (PKR)
Urea	2375.82	1.29	3064.80
DAP	13038.20	1.15	14993.7
Other fertilizers	3278.72	.50	1639.36
Irrigation cost			5350
Intercultural and Plant Protection measures			
Inputs	Cost/unit (PKR)	No. of Operations	Cost/acre (PKR)
Weedicide	1469.83	0.98	1440.43
Pesticides	1213.36	0.66	800.81
Labour			260
Harvesting and Threshing Cost			
Inputs	Cost/unit (PKR)	No. of Operations	Cost/Acre (PKR)
Harvesting cost	6172.65	1.0	6172.65
Threshing cost	6170	1.0	6170
Land Rent			25000
Transportation+ Bardana (bags)			1500
Total cost			79073.31
Gross Income	Price/40 Kg (PKR)	Yield Mounds/acre	Income (Rs/acre)
	2200	41.16	90552
Income from by-product			15233
Total			105785
Net Income/profit			11478.69
Benefit Cost Ratio (BCR)			1.14

Table 4: Estimates of Total Cost, Gross Income, and Profit of Canola (Reported by Crop Reporting Services)

Year	Total cost/acre (PKR)	Gross income/acre (PKR)	Net income/profit/acre (PKR)	Benefit Cost Ratio (BCR)
2020-21	33552	44696	11144	1.33
2021-22	37415	74926	37511	2.00
2022-23	62211	108541	46330	1.7
2023-24	91102	122438	31336	1.34

Table 5: Estimates of Total Cost, Gross Income and Profit of Rapeseed-Mustard (Reported by Crop Reporting Services)

Year	Total cost/acre (PKR)	Gross income/acre (PKR)	Net income/profit/acre (PKR)	Benefit Cost Ratio (BCR)
2020-21	28747	36172	7425	1.25
2021-22	34035	65131	31096	1.91
2022-23	60134	94086	33943	1.56
2023-24	82723	111098	28375	1.34

Table 6: Estimates of Total cost, Gross Income and Profit of Wheat (Reported by Crop Reporting Services)

Year	Total cost/acre (PKR)	Gross income/acre (PKR)	Net income/profit/acre (PKR)	Benefit Cost Ratio (BCR)
2020-21	43743	54518	10775	1.24
2021-22	47432	66402	18970	1.3
2022-23	71774	83017	11243	1.15
2023-24	104292	151497	47205	1.45

Farmer's future plan regarding Rapeseed-Mustard and Canola cultivation

Farmer's opinions on growing rapeseed-mustard and canola on more areas in the future were obtained on a 5-point Likert scale, mainly in the absence of support prices and wheat procurement. The farmers' perceptions of favorable factors that encourage them to allocate more area for rapeseed-mustard and canola in the future, along with their mean scores, standard deviations, and ranks, are presented in Table 7. According to the farmer's opinion, the early maturity of rapeseed-mustard and canola is the most important factor, with a mean score of 4.58. The second factor is the higher prices of oilseed crops relative to wheat, particularly in the present and the last couple of years. The third important factor was the losses

caused by climate change to the wheat crop, particularly the lack of rain during early crop growth stages, high rainfall at crop harvesting time, and the early increase in temperature during grain formation. Absence of support price and procurement of wheat resulting in low market prices, i.e. in the range of 1800-2200/kg. The higher profitability of canola, the lesser use of fertilizer, land preparation costs, and diesel and electricity for rapeseed-mustard and canola, as compared to wheat, are other positive factors that can enhance rapeseed-mustard and canola area and production in the coming years Farmers' intentions to expand rapeseed–mustard and canola cultivation appear strongly influenced by early crop maturity and comparatively higher market prices, which they view as advantages over wheat (Crop Reporting Department, 2024). Additionally, increasing climate-related stresses on wheat, such as erratic rainfall and rising temperatures, further motivate growers to diversify into oilseed crops (Khan et al., 2023). The lower input requirements and higher profitability reported for rapeseed–mustard and canola strengthen farmers' willingness to shift acreage toward these crops in future seasons (Ahmad & Farooq, 2022). Farmers also indicated that the consistently higher profitability of oilseed crops could significantly shift future cropping trends if supported by stable policies and market assurances (Crop Reporting Department, 2024). Likewise, growing uncertainty around wheat prices combined with recurring climatic shocks continues to strengthen farmers' inclination toward rapeseed–mustard and canola as more resilient economic options (Khan et al., 2023).

Table 7: Reasons for allocating more area to Rapeseed-Mustard and Canola in future

Factors	Mean	S.D.	Rank
Early maturity of Rapeseed-Mustard/Canola than wheat	4.58	0.888	1
Higher Rapeseed-Mustard/Canola prices (PKR 4000-6000/40 kg)	4.30	1.102	2
High losses to wheat last year because of climate change	4.24	0.573	3
Low wheat prices (PKR 1800-2200/40 kg)	4.18	0.766	4
Low fertilizer requirements and the price of fertilizer for rapeseed-mustard/canola	4.14	0.843	5
High profitability of canola over wheat	4.11	0.803	6
High fertilizer requirements and price of fertilizer for wheat	3.93	0.898	7
High use of diesel and electricity in wheat production as compared to rapeseed-mustard and canola	3.91	1.240	8

Scale: 1 = strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = strongly agree

Conclusions

Rapeseed-mustard and Canola are more profitable than wheat, being the competing crop. Lack of consistency and flaws in government oilseed policies are discouraging oilseed crops. Periodic announcement of a subsidy of PKR 5000/acre and its denial to many farmers; support price of PKR 2500/40kg in the absence of procurement programs and their enforcement; and the lack/non-availability of production machinery are the perfect examples. Abolishing wheat support price and procurement on the one hand, and the announcement of a PKR 5000/acre subsidy for wheat growers in Punjab, are the second example. Farmers are willing to allocate more acreage to oilseed crops in the future, particularly in the current context of climate change and the discontinuation of support prices and government wheat procurement. Policy makers must exercise due care while devising policies for the competing crops. Policy favoring one crop should not be at the expense of the other crop. Similar policy support should be available for competing crops, for example, support price and procurement for both wheat and oilseed, or none for either

References:

Abbas, M., Akram, M. W., Saeed, I., & Bashir, A. (2010). Economics of non-conventional oilseed crops in central Punjab. Pakistan Journal of Agricultural Research, 23(3–4).

Adil, S. A., Chattha, M. W. A., Bakhsh, K., & Hassan, S. (2007). Profitability analysis of summer vegetables by farm size. Pakistan Journal of Agricultural Sciences, 44(1), 184–188.

Ahmad, B., Bakhsh, K., & Hassan, S. (2004). Economics of growing different summer vegetables. Faculty of Agricultural Economics and Rural Sociology, University of Agriculture Faisalabad, Pakistan.

Ahmad, B., Hassan, S., & Bakhsh, K. (2005). Factors affecting yield and profitability of carrot in two districts of Punjab. International Journal of Agriculture and Biology, 5, 794–798.

Ahmad, S., & Khan, M. A. (2023). Policy challenges in Pakistan's oilseed sector: An assessment of support mechanisms and farmer adoption. Journal of Agricultural Policy and Development, 15(2), 45–58.

Ahmad, T., & Farooq, M. (2022). Economic determinants of oilseed adoption among farmers in Pakistan. Journal of Agricultural Economics and Rural Development, 18(1), 25–38.

Ali, A., Hassan, A., Naseer, M. A. R., Jalilov, S. M., Cuddy, M., Ahmad, S. M., & Bashir, M. K. (2022). Extent and impact of female labor participation in canola production in southern Punjab province of Pakistan. Sustainable Development Investment Portfolio (SDIP) Project, CSIRO, Australia.

Boardman, A. E., Greenberg, D. H., Vining, A. R., & Weimer, D. L. (2018). Cost-benefit analysis: Concepts and practice (5th ed.). Cambridge University Press.

Crop Reporting Department. (2024). Cost of production and profitability estimates for major crops, 2020–21 to 2023–24. Government of the Punjab, Pakistan.

Dhakal, S. C., Regmi, P. P., Thapa, R. B., Sah, S. K., & Khatri-Chhetri, D. B. (2015). Resource use efficiency of mustard production in Chitwan district of Nepal. International Journal of Applied Sciences and Biotechnology, 3(4), 604–608.

Dutta, A. (2016). Impact of improved technologies on productivity and profitability of rapeseed–mustard production at farm level in West Bengal, India. SAARC Journal of Agriculture, 14(2), 126–136.

Farah, A., Haq, A., & Bashir, M. (2022). Determinants of climate-smart agricultural practices adoption among wheat farmers in Punjab, Pakistan. Journal of Agriculture Economics Research, 4, 65–76.

Food and Agriculture Organization of the United Nations. (2021). The state of food and agriculture 2021: Making agrifood systems more resilient to shocks and stresses. https://doi.org/10.4060/cb4476en

Food and Agriculture Organization of the United Nations. (2022). Policies affecting the oilseeds, oils and meal sectors https://www.fao.org/4/y0911e/y0911e04.htm

Food and Agriculture Organization of the United Nations. (2023). The state of food security and nutrition in the world 2023: Urbanization, agrifood systems transformation and healthy diets across the rural–urban continuum. https://doi.org/10.4060/cc3017en

Gan, J., & Kebede, E. (1999). The economic potential of vegetable production for limited resource farmers in south central Alabama. Journal of Agribusiness, 17(1), 63–75.

Global Report on Food Crises. (2022). Global report on food crises 2022. World Food Programme. https://www.wfp.org/publications/global-report-food-crises-2022

Government of Pakistan. (2023). Economic survey of Pakistan 2022–23. Pakistan Bureau of Statistics, Ministry of Finance. https://www.finance.gov.pk/survey_2023.html

Intergovernmental Panel on Climate Change. (2022). Climate change 2022: Impacts, adaptation and vulnerability. Cambridge University Press. https://www.ipcc.ch/report/ar6/wg2/

Islam, M. S., Rahman, K. M., & Hasan, M. K. (2011). Profitability and resource use efficiency of producing major spices in Bangladesh. Bangladesh Journal of Agricultural Economics, 34, 1–13.

Jaffar, A. H., Maqsood, H., Sarwat, Z., Muhammad, A., Habib, A., & Muhammad, A. I. (2016). Estimating the technical efficiency in rapeseed and mustard production: A case study of District Okara. German Journal of Agricultural Economics, 54, 801–811.

Khan, S., Ullah, A., & Mahmood, R. (2023). Climate variability and its impacts on wheat productivity in Punjab, Pakistan. Pakistan Journal of Climate and Agriculture, 12(3), 112–128.

Mehraj, M., Wani, M. R., & Ahmad, A. (2023). Climate change and its impact on agriculture: A review of current trends. Environmental Sustainability, 6(11), 1–12.

Mousavi-Avval, S. H., Rafiee, S., Jafari, A., & Mohammadi, A. (2011). Improving energy use efficiency of canola production using data

envelopment analysis (DEA) approach. Energy, 36(5), 2765–2772.

Omonona, B. T., Egbetokun, O. A., & Akanbi, A. T. (2010). Farmers' resource use and technical efficiency in cowpea production in Nigeria. Economic Analysis and Policy, 40(1), 87–95.

Rahman, M. M., Aravindakshan, S., Hoque, M. A., Rahman, M. A., Gulandaz, M. A., Rahman, J., & Islam, M. T. (2021). Conservation tillage for climate-smart sustainable intensification: Assessing its impact on soil organic carbon, greenhouse gas emission and water footprint of wheat cultivation in Bangladesh. Environmental and Sustainability Indicators, 10, 100106.

Rayhan, S. J., Rahman, M. S., Sammy, H. M., & Saha, S. (2013). Profitability and resource use efficiency of mustard production in Sirajganj district, Bangladesh. Journal of Sher-e-Bangla Agricultural University, 7(1), 30–35.

Raza, A., Ali, S., Ashraf, M., & Parveen, A. (2020). Climate-smart agriculture for sustainable agriculture development. Sustainability, 12(10), 4200.

Rehman, A., Jingdong, L., Shahzad, B., Chandio, A. A., Hussain, I., Nabi, G., & Iqbal, M. S. (2015). Economic perspectives of major field crops of Pakistan: An empirical study. Pacific Science Review B: Humanities and Social Sciences, 145–158.

Sampa, A. Y., Sarker, F., Rahman, M. R., & Begum, R. (2020). Profitability and resource use efficiency of mustard cultivation. SAARC Journal of Agriculture, 18, 195–206.

Sarkar, M. M. A., Rahman, M. H., Haque, M. R., Islam, S., & Sultana, R. (2020). An economic study of the oilseed mustard variety Binasarisha-4 in selected areas of Bangladesh. Saudi Journal of Economics and Finance, 4(11), 506–512.

Wambui, C. M., & Majiwa, E. (2020). Evaluation of technical efficiency of edible oil production: The case of canola production in Kieni West Constituency, Kenya. Journal of Development and Agricultural Economics, 12(1), 59–66.

Yaqoob, M., Tahir, M. N., & Aziz, H. (2022). Economic analysis of climate-smart agriculture practices in Punjab region of Pakistan. Journal of Agriculture and Rural Development, 12(1), 45–56