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The financial analysis of nitrogen fertilizers and planting systems and its implications on maize agribusiness: Evidence from Peshawar, Pakistan

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ABSTRACT

Maize is one of the staple foods that supply the world's food demand. The research aims to determine financial analysis of nitrogen fertilizers and planting systems and its implications on maize agribusiness. The research was conducted in experimental design with a split-plot arrangement comprising four replications. Maize plant density as a system treatment was allocated to main plots (65,000; 75,000; and 85,000 plant per ha). Integrated nitrogen was assigned to sub-plots: control; 0% yard manure (YM) + 100% urea; 100% YM + 0% urea; 50% YM + 50% urea; 75% YM + 25% urea; and 25% YM + 75% urea. Data were recorded on plant harvest, harvest index, and R/C ratio. The result showed that integrated N of 50% Farm Yard Manure + 50% urea in 85,000 plant per ha resulted in a higher harvest index of 31.5% and the highest R/C ratio of 6.2 and enhanced yield of 4,219 kg per ha. This yield almost meets the government's expectations. Total cost was 36,961 PKR, total income was 227,941 PKR, and economic net return reached 190,980 PKR. The government can support the maize crops farmers to activate decomposition household's waste to be organic fertilizer in their house and provide the place for decomposition activity in the crops field to fulfill production government target, food security, and environmental health.

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INTRODUCTION

Maize (Zea mays L.) is a widely crop grown and plays a vital role in food security (Ahmad, Ahmad, et al., 2020; Lesilolo et al., 2018). Maize's rank position is the third after rice and wheat in world food production. A hundred gram of fresh maize grains contains 74.4 g carbohydrates, 4.3 g fats, 361 calories, 1.8 g fiber, 9.4 g of protein, and 1.3 g vitamins (Ali et al., 2014). Maize is known as cereals queen globally as it has the highest genomic yield potential among other cereals. In Pakistan, the total cultivated area was 1.23 million hectares with a production of 5,702 thousand tonnes and an average yield of 4,640 kg per ha at the national level (Ahmad, Hanif, et al., 2020). The use of stable fertilizers show a central part in improving productivity on a sustainable basis. Nitrogen is an essential nutrient that constrains maize production.

Soil is commonly known to be the critically lacking constituent of the world. The problem of soil fertility has been identified as a significant impediment to maize productivity in Pakistan. The nitrogen, phosphorus, and potassium (NPK) are the majority of deficient elements. Nitrogen is a necessary component of plant growth, along with chlorophyll and many other enzymes involved in plant physiological processes. Its presence in the soil influences potassium, phosphorus, and other mineral nutrients' status in the plant. If there is N deficiency, the soil's optimal amount of these nutrients cannot be utilized (Apriani et al., 2017). Nitrogen fertilization plays a significant role in improving soil fertility and increasing crop productivity.

Maize needs nitrogen during the active growth and development periods, and it directly affects dry matter production by increasing photosynthetic efficiency. Nitrogen at the optimal rate is required to support plant growth and yield (Cameron et al., 2013; Shambhavi et al., 2017; Srivastava et al., 2018). The application of nitrogen fertilizer increased grain and biological yield significantly. Nitrogen fertilization increases maize grain yield (43-68%) and biomass (25-42%). Organic and inorganic nitrogen sources have a positive interaction for increasing crop yield and improving soil fertility (Mahmood et al., 2017; Mamiev et al., 2019; Partey et al., 2018; Sofyan et al., 2019; Tonitto & Ricker-Gilbert, 2016). Synergistic effects of nitrogen and organic manure accumulate more total nitrogen in the soil.

Experiments revealed that mixing the combination of inorganic and organic nitrogen application enhances soil fertility, secure nutrient supply, and increase yield. Inorganic and organic nutrients demonstrate numerous benefits in terms of increased nitrogen uptake by plants and the amount of nitrogen available in soil. It also plays a vital role in enhancing maize as fodder for animal production. There is an urgent need to increase the judicious use of available land through the integrated application, particularly nitrogenous fertilizer, to meet the ever-increasing food requirements human population and maintain soil fertility for optimum crop production (Mahmood et al., 2017; Mamiev et al., 2019; Partey et al., 2018; Sofyan et al., 2019; Tonitto & Ricker-Gilbert, 2016). Organic matter like manure promotes seed germination and the crop plants' root growth by improving the water holding capacity and the soil's aeration. Therefore, maize production has a high chance of considerable improvement in yield due to the application of manure and conventional fertilizers. Furthermore, the soil nutrient is a central elementary component of numerous metabolites containing proteins, amino acids, phytochromes, and nucleic acids, in addition to several other nutrients (Cisse et al., 2019). Appropriate nitrogen levels, combined with the increased incorporation of manure, result in an agreeable and palatable fodder yield (Watthier et al., 2019).

Planting density is the most critical factor in increasing yield through intra- and inter-row positioning. Planting population is an essential factor in grain yield. Most plants suffer from unfertile situations that is vulnerable to pest attack and settling at higher planting densities. The ultimate number of plants per area is determined by various factors, including water accessibility, maturity, soil fertility, and row spacing. Increased density reduces the percentage of depriving while increasing grain weight, grain number, and grain rows (Adhikary et al., 2020; Ashrafi & Seiedi, 2011; Srivastava et al., 2018; Zhang et al., 2020). Higher densities encourage canopies to take advantage of solar radiation. The crop's dry matter production is inextricably linked to the utilization of solar radiation, which is influenced by shade. Solar radiation utilization is one of the essential factors in maize production, as it is in all higher plants. Canopy architecture on the vertical distribution of light within the canopy directly influences photosynthetic efficiency. However, as plant population density increases, the conversion of intercepted solar radiation into maize yield decreases due to mutual shading. Furthermore, plant population density affects vegetative and reproductive growth (Khan et al., 2020; Lacasa et al., 2020; Shi et al., 2016).

The effort to increase maize crop production could be influenced by technical, social, and economic factors. The technical factors include farmers' barriers to getting access to technology, input availability, and the social-economic factors include a barrier to getting capital, education level, lower-income, and production input usage. However, the farmer income depends on the amount of production factors cost. It mainly includes soil land availability, fertilizer, human resource, management, and technology advancement (Anggraeni, 2017).

Maize crop production and fluctuating harvesting price makes farmers difficult to take a decision.

Many kinds of research about the increased productivity of maize cultivation have been carried out. However, the economic aspect were still inadequately discussed in those experiments. That is why we need a research about the economic return and financial analysis in maize cultivation concerning fertilizer technology. This study's objective is to assess the financial efficiency of using nitrogen fertilizers and the planting system, and its implications for the development of maize agribusiness.

RESEARCH METHOD

The research was conducted during 2018-19 at Agronomy Research Farm, The University of Agriculture Peshawar, Pakistan. The experiment applied Randomized Complete Block Design (RCBD) having a split-plot arrangement replicated four times. Plant density of 65,000, 75,000, and 85,000 plant per ha) was assigned to main plots. The integrated nitrogen (N) was allotted to subplots in six levels of integrated N: Control, 0% yard manure (YM) + 100% urea, 100% YM + 0% urea, 50% YM + 50% urea, 75% YM + 25% urea, and 25% YM + 75% urea. The seed maize of 30 kg per ha was sown for this research. Desired plant density was retained with the process of thinning. The subplot's length and width were 3 m x 3.5 m, respectively adjusting a total of 5 rows. The required plant density were placed in these five rows per subplot treatment details. The source of mineral nitrogen was urea. The economic aspect was analyzed descriptively on total income, total return, and revenue-cost ratio (R/C ratio).

At harvest maturity, plants in three central rows were counted and then harvested to record plants at harvest. Harvest index was recorded by the formula of grain yield/biological yield x 100. Characteristics unit value of Yard Manure (YM) was nitrogen (0.546%), phosphorus (0.225%), potassium (0.613%), dry matter (20.0%), and moisture (80.0%).

The equation model for analysis is following.

$$X_{qij} = \mu + r_q + N_i + D_{qi} + P_j + NP_{ij} + \varepsilon_{qij}$$

Where Xqij is the randomized factor of integrated N and plant density, μ is general average, rq is replication, Ni is the integrated N, Dqi is component of error random relate to the main plot, Pj is plant density, NPij is the interaction effect of factor nitrogen and P in each level. Also, εqij is a component of error.

Data information on economic aspect for the income of maize used the following formula.

$$Л = TR - TC$$
$$TR = P.Q$$
$$TC = TFC + TVC$$

All unit financial analysis is in Pakistan Rupee (PKR), Л is maize income, TR is total revenue, TC is total cost, P is price, Q is quantity, TFC is total fixed cost, and TVC is total variable cost.

Business feasibility of maize used the formula

$$\frac{R}{C}\, ratio = \frac{TR}{TC}$$

If R/C ratio is more than 1, it means the business is feasible. R/C ratio equals to 1 means break-even and R/C less than 1 means the business is not feasible, no revenue economically.

Azam variety was used in the research experiment because it performed better in Peshawar's agro climatic conditions compared to other varieties. Besides, it showed better results in dealing with disease and pest attack than numerous other maize varieties. Azam is cultivated in the density range of 70,000 – 80,000 plant per ha, harvested in 95 days (PARC, 2021).

RESULT AND DISCUSSION

Crop Production

Maize crop reached more total yield than each control treatment of integrated N. Table 1 shows the results of analysis of variance, where the treatment of plant density and integrated N significantly affected individually on total yield and harvest index of maize crops. The strong interaction of plant density and integrated N treatment affected the total yield of maize crops.

Table 1. Analysis of Variances of Maize Yield

Variance Resources	Total Yield	Harvest Index
Replication	0.620	0.526
Plant Density (P)	17.606**	5.771*
Integrated Nitrogen (I)	71.944**	4.649*
Plant Density x Integrated N	2.039*	0.918

** Significant at the 0.01 level; * significant at the 0.05 level

The Duncan Multiple Range Test (DMRT) regarding plant density and integrated N on maize production is identified in Table 2. Maize total yield improved as the higher plant density and integrated N proportionally. More manure undoubtedly increased the total yield of maize. Integrated nitrogen for any dosage in 85,000 plant per ha indicated higher results than the control treatment. The maize production reached 12,120 kg per ha by 100% urea, and the total yield increased to 12,201 kg per ha when treated by 100% YM. A similar result was statistically observed in either 75% YM or 75% urea. However, the best nutrient intake was 50% YM + 50% urea with the highest total yield result of 12,749.50 kg per ha. It is suggested that another treatment to control weed and nitrogen fixation be added to provide sustainable nutrients (Nasar et al., 2020), and some plant regulators such as Salicylic acid as a hormone be given for maize growth and yield (Arshad et al., 2020). Meanwhile, the soil temperature management technologies can increase agricultural productivity and sustainability while reducing environmental impact (Cameron et al., 2013).

The maize crops agribusiness is common in Indonesia. In fact, the highest result of maize gained in Indonesia with spacing maize plant 20 x 50 using manure is 15 tonnes per ha (Asbur et al., 2019). Another study using swine dung manure gained 25 tonnes per ha and the one with plant density 70 x 30 cm resulted in 3.48 tonnes per ha dried grain (Bhato, 2016) and 40 x 40 cm with guano 10 tonnes per ha gave 239.75 g per sample (Nasution, 2019).

The result of opened planting in Peshawar is lower than that in Indonesia. It was possibly influenced by environmental factors such as the four different seasons, soil characteristics, and maize description. Indonesia has an advantage as a tropical country with only two seasons: wet and dry.

Maize crop harvest index as affected by planting density with integrated N is presented in Table 3. Planting density and integrated N each had significantly ($P \leq 0.05$) affected the harvest index. Planting density and integrated N had no significant interaction. An increasing trend was obtained by planting density up to the specific level of integrated N of 50% YM + 50% urea. However, it decreased, moving towards the integrated N of 75% YM + 25% urea and 25% YM + 75% urea. The high harvest index was produced by planting density of 85,000 plant per ha to integrate 50% YM + 50% urea.

Table 2. Effect of Plant Density and Fertilizer on Maize Yield

Treatment of Fertilizer	Plant Density		
	65,000 (P_1)	75,000 (P_2)	85,000 (P_3)
	.... kg per ha		
Control (I_1)	8,975.50 a	9,203.75 a	9,466.25 a
0% YM + 100% urea (I_2)	10,658.75 bc	11,722.08 bc	12,120.00 c
100% YM + 0% urea (I_3)	11,540.80 c	12,125.00 cd	12,201.01 cd
50% YM + 50% urea (I_4)	12,252.00 de	12,467.02 de	12,749.50 e
75% YM + 25% urea (I_5)	11,618.34 d	12,434.01 de	12,499.89 de
25% YM + 75% urea (I_6)	10,475.70 b	11,964.82 c	12,581.50 de

Numbers followed by the same letter do not differ significantly at the 0.05 level

Table 3. Effect of Plant Density and Fertilizer on Maize Harvest Index

Treatment	Harvest Index
Plant Density	
65,000 (P_1)	28.825 a
75,000 (P_2)	29.837 ab
85,000(P_3)	30.863 b
Integrated Nitrogen	
Control (I_1)	27.442 a
0% YM + 100% urea (I_2)	29.325 b
100% YM + 0% urea (I_3)	30.192 bc
50% YM + 50% urea (I_4)	31.450 c
75% YM + 25% urea (I_5)	30.208 bc
25% YM + 75% urea (I_6)	30.433 bc

Numbers followed by the same letter do not differ significantly at the 0.05 level

Nutrient of nitrogen has impacted harvest index significantly in combination with YM. Maize yield of grains went down after planting density was beyond optimal planting populations mainly due to decline in harvest index. The findings revealed that suitable and stable nutrient supply through manure mixing and inorganic nitrogen practicing might have enlarged comparatively astonishing assimilates percent during the process of developments.

These results are in line with findings of Cisse et al. (2019) which determine that maize harvest index is influenced by inorganic and organic combination, and also application of 30 m^3 per ha swine manure and 20 kg per ha biofertilizers can reduce until 50% of the NPK use without declining grain yields in North China.

Adhikary et al. (2020) and Khan et al. (2017) reported that nitrogen usage from mineral nitrogen and manure increases total N in soil. Cisse et al. (2019) concluded that 30 m^3 per ha pig manure and 20 kg per ha bio-fertilizers usage reduces chemical fertilizer need of at least 50% grain yields in the North China Plain. Nutrient contents of organic sources serve as a soil improvement for crops. They provide substantial nitrogen quantity. Soils receiving poultry manure, and it is alone or combined with mineral nitrogen can improve the soil organic carbon. Organic nitrogen sources release nutrients slowly and contribute to provide the residual pool of organic phosphorus and nitrogen in the soil, and reduce nitrogen leaching and volatile. The advantage of organic nitrogen sources are they get mineralized more slowly than mineral N, resulting in improvement of soil organic matter. The organic sources are crucial to improve the chemical, physical, and biological soil properties (Cisse et al., 2019).

The source of organic nitrogen, such as guano manure, constructs a valuable nutrient consisting of organic matter and improved soil chemicals that contain nutrients, and physical traits such as pores, structure, texture, water content, and biological properties owing to soil organic matter. Organic sources increase soil nutrients and organic matters with slow-release effects of soil properties and crop yield (Cisse et al., 2019). The agronomic use efficiency is greater by integrating N use (Partey et al., 2018). Similar results were proposed by (Asbur et al., 2019; Bhato, 2016). Fertilizers level is highly significant for maize's grain yield due to the application of 180 N: 90 P: 60 K kg per ha + 10 tonnes manure per ha (Adhikary et al., 2020).

Financial Analysis

Financial analysis is essential for any business to know how it progresses, including maize crops agribusiness. We need financial and cost analysis to produce some agribusiness products stated in market price (Ginting, 2017; Indrianti et al., 2020).

The financial analysis of maize was affected by integrated N and plant density (Table 4, 5, 6 and 7). Plant density 65,000 per ha yielded the highest net return on 50% YM + 50% urea by total yield of 12,252 kg, total cost of 36,961 PKR, total income of 197,619 PKR, net return of 160,658 PKR, and R/C ratio of 5.7. Whereas, the density of 75,000 plant per ha on the 50% YM + 50% urea gave the same R/C ratio 5.8 with a little higher difference on total yield of 12,467 kg, total cost of 36,961 PKR, total income of 212,765 PKR, and net return of 175,804 PKR. Plant density of 85,000 with 50% YM + 50% urea reached total yield of 12,749.50 kg, total cost of 36,961 PKR, total income of 227,941 PKR, net return of 190,980 PKR, and R/C ratio of 6.2. All maize crop treatments were feasibly developed for farmer agribusiness, but the highest feasibility was 6.2 regarding 85,000 plants per hectare in 50% YM + 50% urea.

Present research results showed that control treatment's total cost was the lowest (28,355 PKR) among integrated N treatments in all plant density treatments (Table 4). The highest total cost was when treatment used 100% urea (40,022 PKR) in all plant density treatments. The total cost for 100% YM decreased to 34,355 PKR. The treatment of 50% urea + 50% YM, the total cost spent by 36,961 PKR. The total cost decreased when manure used more than urea, such as 75% YM + 25% urea. When it was reversed into 25% YM + 75% urea, the total cost increased again. However, the price of manure was lower than urea. All plant density treatments spent the exact total cost, whereas each integrated N treatment spent a different total cost.

Total income increased as the plant population increased and decreased as urea was used. The total income was almost similar to all populations on 100 YM usage; the farmer income range was 194,120 – 201,893 PKR (Table 5). The 85,000 plant per ha on all fertilizer usage gave the highest total income except control. The maize planted in 85,000 plant per ha with 50% YM + 50% urea provided the farmer the highest total income as 227,941 PKR. In Indonesia, it generated total income 16,978,500 IDR and total cost 7,940,123.05 IDR with plant spacing of 75 cm x 20 cm or 65,000 plant per ha (Apriani et al., 2017).

The farmer got a break-even point proportional to total income but inversely proportional to the total cost. The control in 65,000 plant density met the lowest total cost and income, resulting from the lowest net return (95.804 PKR) (Table 6). The higher density indicated a higher net return (111,618 and 124,828 PKR). The control treatment at all density showed the lowest net return among all integrated N treatments.

The higher plant density in all integrated N treatments showed the highest net return. Integrated nitrogen by higher urea showed a lower net return. Simultaneously, the higher nitrogen by the higher manure showed a higher net return. Nevertheless, it went down when the urea had a higher dosage than manure. The highest net return owing to maize crop production was 190,980 PKR by the balanced dosage of 50% YM + 50% urea in 85,000 plant per ha. Furthermore, Table 6 shows that I3 and I6 treatment indicated a similar net return.

Table 4. Effect of Plant Density and Fertilizer on Total Cost of Maize Crops

Treatment of Fertilizer	Plant Density		
	65,000 (P_1)	75,000 (P_2)	85,000 (P_3)
	.... Pakistan rupee		
Control (I_1)	28,355	28,355	28,355
0% YM + 100% urea (I_2)	40,022	40,022	40,022
100% YM + 0% urea (I_3)	34,355	34,355	34,355
50% YM + 50% urea (I_4)	36,961	36,961	36,961
75% YM + 25% urea (I_5)	35,722	35,722	35,722
25% YM + 75% urea (I_6)	38,456	38,456	38,456

Table 5. Effect of Plant Density and Fertilizer on Total Income of Maize Crops

Treatment of Fertilizer	Plant Density		
	65,000 (P_1)	75,000 (P_2)	85,000 (P_3)
	.... Pakistan rupee		
Control (I_1)	124,159	139,973	153,183
0% YM + 100% urea (I_2)	165,089	185,036	200,902
100% YM + 0% urea (I_3)	194,120	196,973	201,893
50% YM + 50% urea (I_4)	197,619	212,765	227,941
75% YM + 25% urea (I_5)	185,887	208,217	210,153
25% YM + 75% urea (I_6)	172,402	193,185	206,268

Table 6. Effect of Plant Density and Fertilizer on Net Return of Maize Crops

Treatment of Fertilizer	Plant Density		
	65,000 (P_1)	75,000 (P_2)	85,000 (P_3)
	.... Pakistan rupee		
Control (I_1)	95,804	111,618	124,828
0% YM + 100% urea (I_2)	125,067	145,014	160,880
100% YM + 0% urea (I_3)	159,765	162,618	167,538
50% YM + 50% urea (I_4)	160,658	175,804	190,980
75% YM + 25% urea (I_5)	150,165	172,495	174,431
25% YM + 75% urea (I_6)	133,946	154,729	167,812

Table 7. Effect of Plant Density and Fertilizer on R/C Ratio of Maize Crops

Treatment of Fertilizer	Plant Density		
	65,000 (P_1)	75,000 (P_2)	85,000 (P_3)
Control (I_1)	4.4	4.9	5.4
0% YM + 100% urea (I_2)	4.1	4.6	5.0
100% YM + 0% urea (I_3)	5.3	5.7	5.9
50% YM + 50% urea (I_4)	5.7	5.8	6.2
75% YM + 25% urea (I_5)	5.2	5.8	5.9
25% YM + 75% urea (I_6)	4.5	5.0	5.4

Feasibility Analysis

The revenue-cost analysis quantifies the impacts on all society members arising from implementing an agribusiness or policy. The selected and measured quantification is directed to agricultural projects that involve maize crops smallholders.

All of the maize production was feasible to develop as indicated by the R/C ratio of more than one. The R/C ratio is the critical level for deciding whether the business can operate or not. Net return is proportional to the R/C ratio. The higher the net return produces the higher the R/C ratio is. The maize crop production is a profitable business in Peshawar. Without any integrated fertilizer, the 85,000 plant per ha showed R/C ratio of 5.4 (Table 7), same as 25% Y + 75% urea and lower in 100% urea. The highest R/C ratio was 50% YM + 50% urea.

Furthermore, Table 7 shows the value of feasibility of at least 4.1. It means whenever maize crops agribusiness spends 1 PKR, it will gain revenue of 4.1 and profit of 3.1 PKR. The highest feasibility value (6.2) indicated that maize crops are planted in 85,000 plant per ha in which the balance of manure and urea dosage are at 1:1 proportion. The maize agribusiness feasibility in Indonesia is found to be 1.51 (Apriani et al., 2017); while Sumatera (Indonesia) reached an R/C ratio of 2.51 (Ginting, 2017) and 1.87 in Papua (Indonesia) (Palobo, 2019). Although it is feasible, it is lower than Pakistan's R/C ratio. Indonesia has various soil conditions and soil chemical properties due to different genesis in each region geologically.

Table 8. Farmer's Response to Maize Cultivation and Agribusiness

Number of Respondent	Percentage	Classification
30	73.50	Very Good
7	17.60	Good
3	5.90	Less
2	3.00	Bad
Total (n=42)	100.00	

Respondents supported planting maize crops agribusiness recommendation based on research because it has high demand and income growth. The maize biomass could be used as forage for livestock and fire torch. Respondents commented with "very good" (73.50%), "good" (17.60%), "less" (5.9%), and "bad" (3%) (Table 8). The 3% of respondents said bad since there were other crops. The farmer hoped there was market certainty to ensure that their crop production would be sold and bought by consumer and private sectors. It would keep maize crops and farmers sustainable.

Research Implication

Manure improves the texture of the soil, recycles nitrogen, and introduces beneficial bacteria. Because the pasture has been improved, the animals are fattening up faster. Fertilizers can help reclaim marshland for pasture after it has been drained. This availability is beneficial to plants and waterways, but less watering and fertilizing can save a significant amount of money.

The use of alternatives sources to organic fertilizer will reduce the amount of fertilizer required. Some organic nitrogen-adding methods for soil are planting a green manure crop such as forage, planting nitrogen-fixing plants like peas or beans, adding composted manure to the soil, and incorporating coffee grounds into the soil. Plants require nitrogen compounds from the soil to grow, which can be produced naturally or provided by fertilizers. On the other hand, excess fertilizer application results in the release of harmful greenhouse gases into the atmosphere and the eutrophication of our waterways. Fertilizers are manufactured with a certain ratio of NPK. These nutrients are dissolved and quickly reach the cells of a plant, where they are required. This nutrient consistency in fertilizers enables commercially efficient production. Organic-based fertilizers, as empirically demonstrated, can help boost both nutrient efficiency and organic matter content in the soil, reduce reliance on chemical inputs, restore and maintain soil fertility to foster plant growth, nurture the soil with organic matter, and replace the nutrients that crops remove from the soil.

Fertilizers replenish the nutrients lost by crops in the soil. Crop yields and agricultural productivity would be significantly reduced if fertilizers were not used. That is why mineral fertilizers are used to supplement the soil's nutrient stocks with minerals easily absorbed and utilized by crops.

Compost and other organic fertilizers have been shown to increase soil nutrient levels. Organic matter provides a ready source of carbon and nitrogen for soil microorganisms, improves soil structure, reduces erosion, lower soil temperatures, facilitates seed germination, and increases the capacity of soil water retention. Organic farming can restore the damaged soil's natural fertility by increasing soil organic matter, which increases crop productivity to feed the growing population. Organic fertilizers improve natural soil processes, which have long-term effects on soil fertility. Organic fertilizer can be made from various sources, including minerals, animal waste, sewage sludge, and plants.

Global crop production must double between 2005 and 2050 to meet the rising demand for food and biofuels. Nitrogen is the essential nutrient for crop growth, so it must be added to increase crop yield — usually through fertilizers and manure, but in some cases through nitrogen fixation by leguminous crops. However, only about 42–47% of the nitrogen applied to croplands worldwide is harvested as a crop product. The majority of the remainder is lost to the environment, which endangers human and ecosystem health on a local to global scale.

Government policies affecting the domestic economy, foreign affairs, and trade initiatives can significantly impact the agricultural sector. Government agencies at the state level promote local agricultural products, offer food safety and inspection services, soil conservation, and environmental protection. By encouraging modern agriculture inputs, the government has provided farmers with massive subsidies on agricultural inputs such as irrigation, fertilizers, power, production, and productivity. Subsidies are given to farmers for a variety of inputs under this policy. The government has taken several initiatives to develop the agriculture sector, remunerative returns for farmers' produce, and reduce the production cost, thereby reducing the cost of fertilizers and implementations using organic and inorganic minimize the high cost of synthetic fertilizers.

Pakistan's maize production in 2020 was 7,000 thousand tonnes. Pakistan's maize production increased from 705 thousand tonnes in 1971 to 7,000 thousand tonnes in 2020, growing at a 5.15% annual rate (Ahmad, Hanif, et al., 2020).

Government policy about maize crop's sustainable development is crucial to follow up. Those are to increase farmer prosperity and zero hunger as support of United Nation Program of 17 SDGs (FAO, 2018; Wahyuningsih, 2018) and breakdown by all division and spread out to countries worldwide with any development policies.

Maize is the most important crop in terms of agronomy and global economic impact. Maize produces good crops in a variety of climatic zones, and it thrives in areas that are too dry for rice but too wet for wheat, fitting into a niche between the two. Land, labor, and capital are continuous factors of production in agriculture. Fertilizer, rainfall, and soil all play a role in agricultural output production. With a one-inch decrease in rainfall and a high temperature of 35°C, maize yield drops by 9% (Partey et al., 2018). Thus, even if farmer have developed maize varieties that grow well in various biophysical environments (Abbas et al., 2020; Partey et al., 2018), good maize productivity is still threatened by the effects of climate change.

CONCLUSION AND SUGGESTION

The integrated N of 50% Yard Manure + 50% urea resulted in a higher harvest index of 31.5%, the highest R/C ratio of 6.2, and enhanced yield of 4219.55 kg per ha. It also generates the total cost of 36,961 PKR, total income of 227,941 PKR, and economic net return of 190.980 PKR. This yield almost meets the government's expectations.

The government can support the maize crops farmers to activate decomposition household's waste to be organic fertilizer in their house and provide the place for decomposition activity in the crops field to fulfill production government target, food security, and environmental health in Pakistan. This information is essential for generating suitable fertilization usages to reach a higher yield of maize.

The maize crops' incremental net benefit was positive, which signifies an addition to the maize agribusiness economics. The government's initiative is required to offer sufficient monetary incentive for farmers to engage in it. The net income or revenue change is expected to be positive and covering the initial investment and operational expenses. Thus, the analysis and results showed might be a model for future government investment evaluations intended to assist poor and middle smallholder farmers.

The research provides a suggestion to meet the national production targets, food protection, and environmental health in Pakistan. The government must recognize the effect of increasing input costs on farmers' meager incomes. The shift is from a cash subsidy scheme to a tax relief scheme that would prevent financial capital from being wasted and directly benefit the farming community. It will boost crop productivity, which will benefit the rural economy. As a result, the government should emphasize policy reform rather than fiscally unsustainable subsidies.

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