ASSESSING PRODUCTIVITY AND PROFITABILITY OF HYBRID MAIZE USING NUTRIENT EXPERT® MODEL SET IN JHAPA.

SWASTIKA CHAUHAN

RESEARCH REPORT
SUBMITTED TO
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This research report hereto, entitled **"ASSESSING PRODUCTIVITY AND PROFITABILITY OF HYBRID MAIZE USING NUTRIENT EXPERT® MODEL SET IN JHAPA "** prepared and submitted by **MRS. SWASTIKA CHAUHAN,** in the fulfillment of the requirements of the **Undergraduate Practicum Assessment** for the Bachelors of Science in Agriculture, is hereby accepted.

……	……..
Asst. Prof. Lal Prasad Amgain, PhD	**Asst. Prof. Roshan Subedi**
Advisor, Advisory Committee	**Member, Advisory Committee**
Date:	**Date:**

……..
Asst. Prof. Lal Prasad Amgain, PhD
Campus Chief, Lamjung Campus
Date:

Accepted as the fulfillments of the Undergraduate Practicum Assessment for the degree of Bachelors of Science in Agriculture

……..
Prof. Gopal Bahadur K.C., PhD
Assistant Dean (Academics)
Institute of Agriculture and Animal Science
Date:

DEDICATED TO

My grandparents **Mr. Ganesh Bahadur Chauhan**, **Mrs. Bhadrika Devi Chauhan** and my parents **Mr. Chopendra Chauhan** and **Mrs. Tulsha Chauhan.**

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ACRONYMS

*	Significant
**	Highly significant
°	Degree
ANOVA	Analysis of Variance
CV	Coefficient of Variation
DAS	Days after Sowing
FP	Farmer Practice
FYM	Farm Yard Manure
g	gram
GR	Government Recommendation
IPNI	International Plant Nutrition Institute
LSD	Least Significant Difference
m	meter
MoAD	Ministry of Agriculture Development
NE	Nutrient Expert
NRNA	Nonresidential Nepal Association
NS	Non Significant
Rs	Rupees
SEm	Sum of Error of Mean
SS	Sum of Square
t/ha	ton/ hacter
VDC	Village Development Committee

ABSTRACT

Maize is second important food crop in Nepal and its demand is increasing year by year. However, its productivity is constrained by a number of problems out of which site specific nutrition management is the most important one. Therefore, a field experiment was conducted on a farmer's farm land at two district of Jhapa viz.Dhukurpani and Gauradha using Nutrient Expert® Maize model from 28th November 2014 to 17th May 2015. The research design was Randomized Completely Block Design with 3 treatments and 11 replication. Three treatments are NE (Nutrient Expert recommendation), GR (Government recommendation), and FP (Farmer practices). Significant difference in terms of no. of plant/m^2, kernel no. /row, shelling%, test wt. and Yield at 15.5% moisture was found. Heighest yield (11.99 ton ha^{-1}) was obtained from NE field which was followed by GR (8.67ton ha^{-1}) and FP (7.31ton ha^{-1}). NE based practices gives (4.68 ton) more yield and (Rs. 93545.05) more gross revenue than FP andwith comparision to GR it produced (3.32 ton ha^{-1}) more yield and (Rs. 66404.24) more gross revenue. Comparison of Nutrient Expert® (NE) estimated attainable maize yield and gross revenue given by Nutrient Expert® hybrid maize model versus actual maize yield and gross revenue in farmer field trail NE-based fertilizer recommendations proved to be successful in reaching the yield targets estimated by the software. The actual maize yields recorded in farmer fields were higher than the NE estimated attainable yields. NE recommendation was found better over GR and FP. Higher yield and profitability from hybrid maize was obtained from NE based recommendation.

Key words: Nutrient expert, Government recommendation, Farmer practice, hybrid, site-specific nutrient management

1 INTRODUCTION

1.1 Background

Maize (*Zea mays)* is second important crop of Nepal after rice in terms of area grown and production (MoAD, 2013). It has a very high yield potential than any other cereals and thus popularly known as 'queen of cereals'. Maize contributes about 6.88 % of the total agricultural GDP supplied to the nation (MoAC, 2008). In 2008/2009, maize was grown in about 875,428 ha which represents 25.6% of the total area has planted to cereals in Nepal. In the same period, 1930670 metric tons of maize was produced, representing about 23.8% of Nepal's total cereal production. In the recent years, maize has come up as new and promising cash crop in the terai region due to growing number of demand in feed industry sectors. Its demand has been constantly growing by about 5% annually throughout in the last decade as it is cultivated as food, feed and fodder. Its production is growing largely due to dual purpose, growing poultry industry to meet the demand for the grain and for good quality stover to feed cattle and it is also replacing crops like rice, sorghum, legumes and wheat in some area. (Annual report, 2013). Maize along with rice and wheat crop provide 30% of calorie of 4.5 billion people in 94 developing country (Annual report, 2013).

According to USDA production, supply and distribution by market year statistics, maize production in Nepal increased by 400,000 tons (i. e, 20%) from 2004 to 2013. Research finding shows that HRMP increased maize productivity by 37% since 2010. Maize is not only the food crop but it is viewed as cash crop for selling and thus earning the income and raising the livelihood of low income farmers.

Being deep rooted crop with adventitious root system; it extract higher nutrient from the soil and also due to higher grain and stover yield its nutrient requirement is higher, so there is possibility of nutrient mining from the soil if nutrient is not added to the soil. Thus, nutrient management is the major concern in maize along with the increase in area of production.

Government of Nepal provides region based fertilizer recommendation, single fertilizer dose recommendation for each terai, hills, and mountain but nutrient status of the field vary from farmers field to field, and government recommendation fertilizer dose is impractical to meet the demand of specific crop at specific sites. Also this government based fertilizer recommendation is also not widely used by farmer due to insufficient dissemination of the developed technology.

Farmers have small sized of land holding and practise intensive cropping system. They apply fertilizer as per their wish. Imbalanced use of fertilizer (use of either higher or lower dose of fertilizer) gives low economic return, low productivity and unsustainability of production. On contrary to this, hybrid maize is a high nutrient demanding crop and its sustainable production can only be achieved by site specific specific nutrient management practice.

Nutrient Expert® an innovative, information and communication technology (ICT) -based decision support systems (DSS) tool such NE for maize, rice and wheat has been developed and evaluated across several farmers' fields in South and SE Asia by the International Plant Nutrition Institute (IPNI) and the International Maize and Wheat Improvement Centre (CIMMYT). The NE is an easy-to-use, simple computer based tool that can rapidly provide nutrient recommendations for nitrogen, phosphorus and potassium for above crops for individual farmer's fields in presence or absence of soil testing results. Evaluation trials and other studies in India have clearly highlighted the superiority of NE-based nutrient recommendations over farmer's existing practices and state-based recommendations in terms of yield and profitability, as well as for addressing adverse impacts of climate change through mitigation of greenhouse gases emitted from agricultural fields. Thus, NE has now been selected as the best ICT solution for improving rural livelihood especially in Bihar and West Bengal, and to its credit the IPNI recently received the best innovation award from the Government of Bihar.

Working Modality of Nutrient Expert for Hybrid Maize:

- develop an optimal planting density for a location
- evaluate current nutrient management practices
- determine a meaningful yield goal based on attainable yield
- estimate fertilizer NPK rates required for the selected yield goal
- translate fertilizer NPK rates into fertilizer sources
- develop an application strategy for fertilizers (right rate, right source, right location, right time), and
- compare the expected or actual benefit of current and improved practices

1.2 Objectives of study

Broad

- To enhance the economic status of farmer by increasing the productivity of maize.

Specific

- To estimate the growth and yield of maize using Nutrient Expert® -Maize.
- To assess the yield and profitability of maize in farmers field using Nutrient Expert ®-Maize in Jhapa.
- To evaluate the Nutrient Expert ® -Maize model.

1.3 Hypothesis testing

Null Hypothesis (H_0): Productivity of maize from nutrient expert recommendation won't be higher than from government recommendation and farmer practices.

Alternate Hypothesis (H_1): Productivity of maize from nutrient expert recommendation will be higher than from government recommendation and farmer practices.

2 REVIEW OF LITRATURE

2.1 Hybrid maize production scenario

Maize is the second important crop after rice in Nepal. Each year its demand is increasing by 5% as its uses for the fuel and as feed for poultry and animal has increased. Greatest area of maize production lies in mid-hills (70%) followed by Terai (22%) and high hills (8%) (MoAD, 2013). A large portion of maize harvest comes from eastern (667 thousand Mt.) and central development region (650 thousand Mt.) with their share of national production estimated 29% each. (MoAD, 2013).

Replacement of open pollinated variety by hybrid maize increase the production and productivity of maize. Hybrid maize have high production potential but less planting density and poor nutrient management are responsible for reducing the yield in the developing country(3t/ha) as compare to developed country(more than 8 $tonha^{-1}$).

2.2 Site specific nutrient management

The SSNM concept was first developed for irrigated rice in Asia (Dobermann *et al.*, 2002; Witt *et al.*, 2007; IRRI, 2007).The amount of nutrients taken up by a crop is directly related to its yield (Janssen *et al.*, 1990) so that, the attainable yield indicates the total nutrient requirement and the nutrient-limited yield is the yield supported only by the indigenous supply of the concerned nutrient without any external application (Dobermann *et al.*, 2003).

SSNM is an approach for "feeding" crops with nutrients as and when needed. It advocates:

- Optimal use of existing indigenous nutrient sources (e.g. crop residue, manure).
- Timely application of fertilizers at optimal rates
    - To meet deficit between the nutrients needs of a high-yielding crop and the indigenous nutrient supply.

2.3 Nutrient Expert:

Based on these SSNM principle Nutrient Expert® -Maize was developed. Nutrient Expert® for Hybrid Maize (NEHM) for favorable tropical environments (e.g., Southeast Asia) was developed in late 2009 and underwent field evaluation in Indonesia and the Philippines. It was developed for South East Asia in 2010/11 which enable the maize growing farmer of this region to implement SSNM for their individual field. It can provide the nutrient recommendation for farmer in presence or absence of soil testing data. It utilizing the information given by local expert or farmer to suggest meaningful yield goal for his location and formulate a fertilizer management strategy require to attain the yield goal (Satyanarayana *et al.,* 2014).

NE concept has been adapted to other crops like wheat, rice and other to geographic regions like China, Kneya and Zimbabwe. In 2011, beta versions of NE for maize were developed for South Asia, China, Kenya and Zimbabwe. Likewise, beta versions of NE for wheat were developed for South Asia as well as China. In 2013, field-validated versions of NE maize and NE wheat have been released for public use in South Asia and China (Witt *et al.,* 2008).

SSNM are usually measured in nutrient omission trials conducted in farmers' fields, which require at least one crop season and with NE, parameters can be estimated using proxy information, which allows farm advisors to develop fertilizer guidelines for a location without data from the omission trail so, it save both time and money.

In the field experiment conducted to study the effect of variety and nutrient management on growth and yield of maize under Lateritic belt of West Bengal during 2013 at farmers field. It was found that application of nutrient based on decision support system i.e. nutrient expert gives highest yield and yield parameter value as compared to state recommendation and farmers practice. % of Grain yield increase using nutrient expert recommendation over farmer practice, state recommendation and LCC based recommendation were 74%, 32%, and 4% respectively. Similar result was observed by Nottidge *et al.,* 2011. Highest plant height, dry matter at harvest grain yield and Stover yield was found on nutrient expert recommendation

field. Agronomy efficiency, Recovery efficiency and physiological efficiency of applied nitrogen was found highest in nutrient expert based recommendation (Banerjee *et al.*, 2014).

The Nutrient Expert validation trials conducted at Bheemarayanagudi, Karnataka resulted that the Nutrient Expert (NE)-based field-specific fertilizer recommendations offered solutions to the Nutrient farmers of southern India for better nutrient use in maize under the current scenario of escalating fertilizer prices. Results from validation trials, comparing NE-based recommendations with FP and SR in 82 farmer fields of southern India, demonstrated the utility of the decision support system tool in improving the yield and profitability of maize farmers of Karnataka, India .The result revealed that recommendation from Nutrient expert- maize increased yield by 1.06 tonsha^{-1} on an average as compared to farmer practice and by 0.9 tonsha^{-1}as compared to the state recommendation and also increased the income due to reduction of fertilizer cost (Satyanarayana *et al.*, 2012).

On-farm nutrient omission trials in Haryana under contrasting tillage and residue retention treatments showed that wheat yield varied across sites. Site-specific nutrient recommendations from Nutrient Expert, a recently developed wheat nutrient decision support tool, increased wheat yields and farmer profits over existing farmer fertilizer practices and generalized recommendations under both Convention tillage and in Conservation Agriculture (Kumar *et al.*, 2012).

Research result from NE-Wheat (the result from 100 farmers field trail) conducted in Jhapa and Morang district, presented by FORWARD's director Mr. Ram Krishna Neupane Presented that farmers could get 0.5 t/ha more yield compared to government recommendation and 1.2 t/ha more yield compared to farmer's fertilizer management practice. For every additional Nepali Rupee (NRs) spent on additional fertilizer application as per NE recommendation, farmers would get a return of NRs 3.87 (Benefit/Cost 3.87:1) over GR and 3.28 over FFP. Farmer representatives from both the project (Timsina, 2015).

3 MATERIALS AND METHODS

3.1 Location of the experiment site

This study was conducted in Eastern Nepal in Jhapa district in amalgamation with FORWARD, Nepal, NRNA-NCC Australia and IPNI, Delhi project "Transfer, Evaluation and Dissemination of an Innovative Fertilizer Management Tool (Nutrient Expert®) for Increasing Crop Yields and Farmers' Income in Eastern Nepal". Two site of Jhapa namely Dhukurpani and Gauradha which lies in Damak municipality was selected as it was the major winter maize growing area. The site is located at an elevation of 1,350 m with the latitude of $26^0$22'00" N and longitude of $88^0$12'00" E with the altitude of 70 m to 506m (Wikipedia, 2015). The experiments were carried out in selected Farmer's field. A preliminary survey was done in 2 VDCs for selection of farmer's field. Total of 11 farmers were chosen for the experimental trails.

Figure 1: Map of Nepal indicating Jhapa district

shows research site

Figure 2: Map of Jhapa indicating the research site

3.2 Questionnaire

Farmers of each municipality was collected, among them farmer mostly growing maize was selected. The prepared questionnaire based on the nutrient expert model software was used and detail information was obtained by interview with the farmer and visiting the farmers' field. Questionnaire was filled up from 28th November 2014 to 30th Nov 2014.

3.3 Soil sampling and analysis

5 household of each municipality was selected to take the representative soil sample of the project side. For soil sampling Z pattern was drawn, soil from 20 cm depth was collected and representative soil sample was prepared by mixing it well and was sent to soil testing laboratory Tarhara and some of the sample was sent to IPNI lab of India to test the nutrient status of the soil..

3.4 Manure sampling and analysis

For the nutrient content of farm yard manure and poultry manure, 2-3 sample of FYM and poultry manure was collected and send to IPNI research laboratory to know about the nutrient content.

3.5 Set up of the trail

3.5.1 Research design

Randomized Complete Block Design with 3 treatment and 11 replication was set up (no. of replication = no. of farmer).

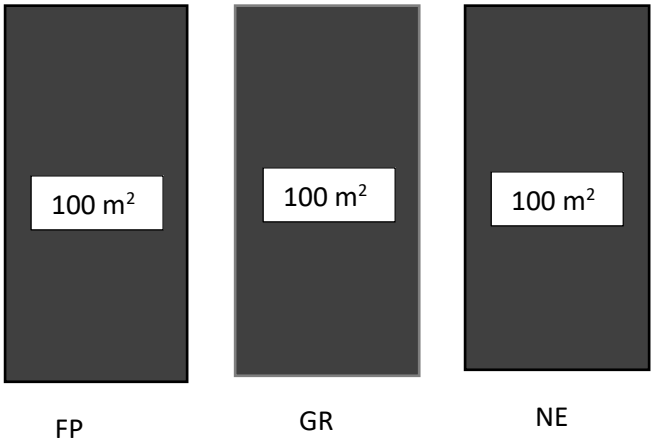


Figure 3: Layout Design of single replication

3.5.2 Treatments

NE – Nutrient Expert® -Maize recommended spacing and fertilizer dose

GR – Government recommended spacing and fertilizer dose

FP – Farmer own practice of seed rate and fertilizer dose

3.5.2 Nutrient recommendation

- For nutrient expert field, nutrient recommendation for individual farmer field was given by nutrient expert software model

  Dhukurpani: 105: 47: 49 N, P, K (kg/ha)

  Gauradha: 111: 48: 55 N, P, K (kg/ha)

All the doses of P and K, half doses of N was applied at basal dose and remaining half dose of N was applied 50 DAS.

- Government recommendation field, district based government recommendation dose of fertilizer was used i.e. 100: 50: 25 N, P, K (kg/ha).

  All the doses of P and K, half doses of N was applied at basal dose and remaining half dose of N was applied 40 DAS.

- Farmer's field: In farmer field plot farmer had their own previous practice fertilizer dose and application time.

3.5.3 Plot size

Gross plot size 100 m^2

Net plot size 5 m^2 from where yield attributing data was taken.

Figure 4: A farmer inside the 5 m^2 net plot within the gross plot of NE during knee high stage of crop.

3.6 Cultivation practices

3.6.1 Field preparation

Field will be prepared first by using a tractor. A deep ploughing was done on Dec. 3rd 2014. Final field preparation was completed on 10th Dec. 2014. Fine soil was prepared for the proper plant establishment.

3.6.2 Sowing

Maize was sown on 8th – 10th December

3.6.3 Sowing method

Line sowing was done

3.6.4 Spacing

NE: 60 * 20 cm^2, GR: 50 * 25cm^2 farmer field:

3.6.5 Depth of sowing

Seed was sown at the depth of 3 - 4 cm.

3.6.6 Intercultural operation

Weeding was done after 30 DAS, loosening and earthing up was done after 45 DAS.

3.6.7 Harvesting

Harvesting and data collection was done from 13/05/2015 to 17/05/2015. Harvesting was done manually.

3.7 Observations

Yield attributing character

3.7.1 No of cob / plant

From the net plot five plants was selected and no. of cobs / plant was counted for each treatment.

3.7.2 No. of row / ear

From the harvested ear, no. of row/ ear was counted for each treatment. The no. of row of 10ear was taken and average was done for each treatment.

3.7.3 No. of kernel / row

No. of kernel from each row was counted for each treatment. 10 ear was selected and no. of kernel/ row was counted and average was done to find out the average kernel number per row.

3.7.4 Kernel yield:

At fully maturity all the plant from the net plot was harvested to record the kernel yield. Weight of the harvested cob was taken before shelling and hand shelling to find out the shelling %. The grain yield per hector was computed for each treatment from the net plot yield.

3.7.5 Moisture %

Moisture percentage of maize was calculated by using digital moisture meter. The final grain yield was adjusted at 15.5% moisture. The used moisture meter is Wile-55grain moisture meter of Farm Comp Company.

Kernel yield (kg/ ha) at 15.5% moisture: $\frac{(100\text{-MC}) * \text{plot yield (kg)} * 10000\ (m^2)}{(100 - 15.5) * \text{Net plot area}}$

Where, MC is the moisture content in percentage of grain.

3.7.6 Test weight

1000 grain weight was taken from the grain yield of net plot for each treatment and weight with the help of portable weighing balance.

3.8 Data entry and analysis

Microsoft word was used for data processing, MS excel for data input, table, charts, graphs and simple statistical analysis. IBM SPSS Statistics 21 was used for statistical analysis. ANOVA was done at 0.05% level of significance.

Table1: ANOVA table.

Source of Variations (SOV)	Degree of freedom (df)	Sum of Square (SS)	Mean Sum of Square (MSS)	Computed value	Probability (0.05)
Treatments (t)	(t-1) (3-1) = 2	SS1	SS1/10 = MS1 MS1/MS2		
Replication (r)	(r-1) (11-1) = 10	SS	SS2/2 = MS2 MS2/MS3		
Error	(t-1) (r-1) (2 * 10) = 20	SS3	SS3/20		
Total	(tr-1)				

4 RESULTS AND DISCUSSION

4.1 Simulated yield and economics given by Nutrient Expert® Hybrid maize model software.

The Nutrient Expert for Hybrid Maize is a new, computer-based decision support tool developed to assist local experts to quickly formulate fertilizer guidelines for tropical hybrid maize based on the principles of site-specific nutrient management (SSNM) described by Witt *et al.* (2009). From the information obtained from farmer this software provide the optimum plant density, proper nutrient management by providing N, P, K dose from the available organic and inorganic source of fertilizer, and based on attainable yield of crop on those location, it estimates yield at 15.5% moisture, revenue, cost of seed and fertilize, expected benefit above seed and fertilizer . It also calculate the change in benefit of individual farmer from their own practices and by adopting the NE- Maize.

Table 2. Simulated Yield and economics given by Nutrient Expert® model software

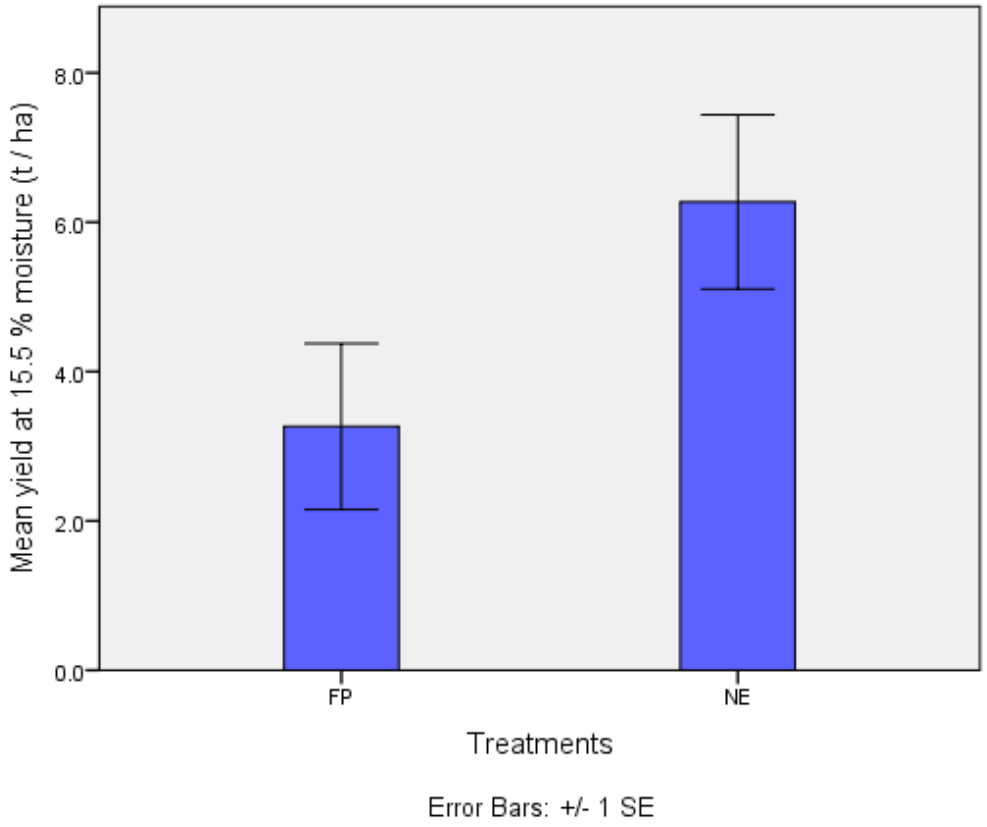
Treatment	Yield at 15.0 % moisture (t ha^{-1})	Revenue (NRs ha^{-1})	Cost of seed and fertilizer (NRs ha^{-1})	Expected benefit above seed and fertilizer (NRs ha^{-1})
Farmer's practice (FP)	3.264	55464	28704	26760
Nutrient expert (NE)	6.273	106955	23768	83186
SEm (±)	0.0902	2590.9	4591.1	4976.9
LSD (P=0.05)	0.284 **	8164 **	NS	15682.4 **

Non-significant (NS); highly significant "**"

4.1.1 Yields at 15.5% moisture (tonha^{-1})

Simulated yield at 15.5% moisture was given by Nutrient Expert® model by the data collected from farmer. Highly significant result was found between FP and NE in terms of yield. Simulated yield of NE field was found double of FP. Higher yield was due to optimum plant

population, right dose of fertilizer recommendation and application at right time. CV % (35.3) was due to high variation in between two field where research was conducted and high variation among each farmer practices.

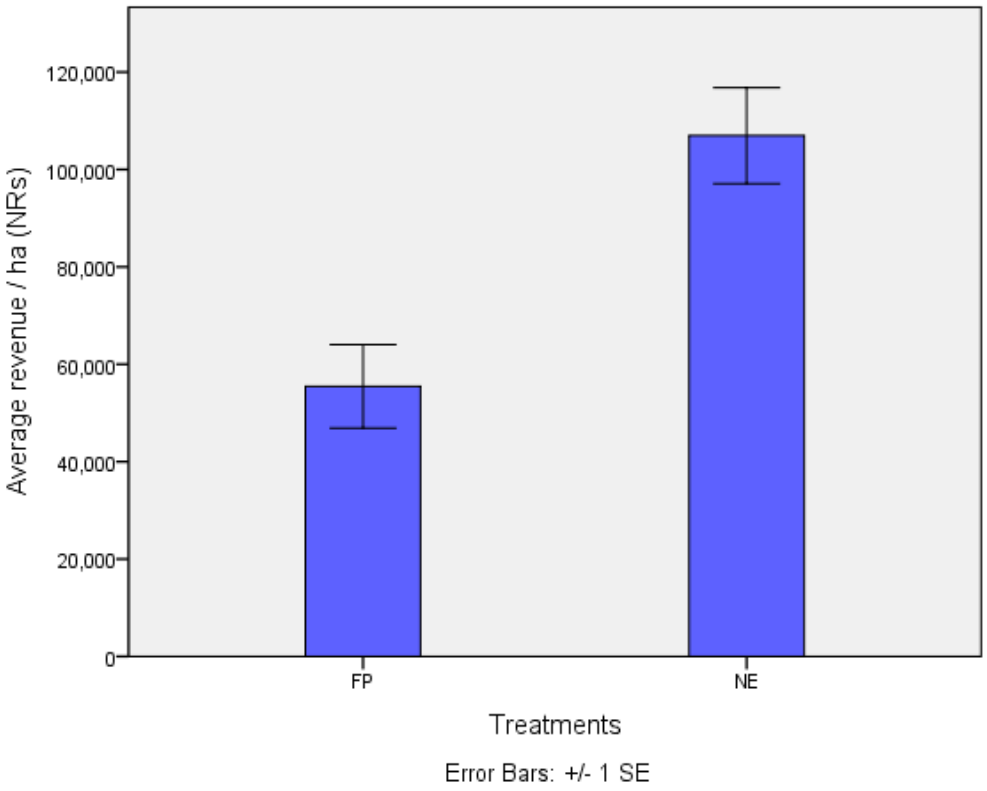


FP: Farmer Practice
NE: Nutrient Expert

Figure 5: Mean yield at 15.5 % Moisture (t / ha) in different treatments given by NE model

4.1.2 Revenue ha^{-1} (NRs)

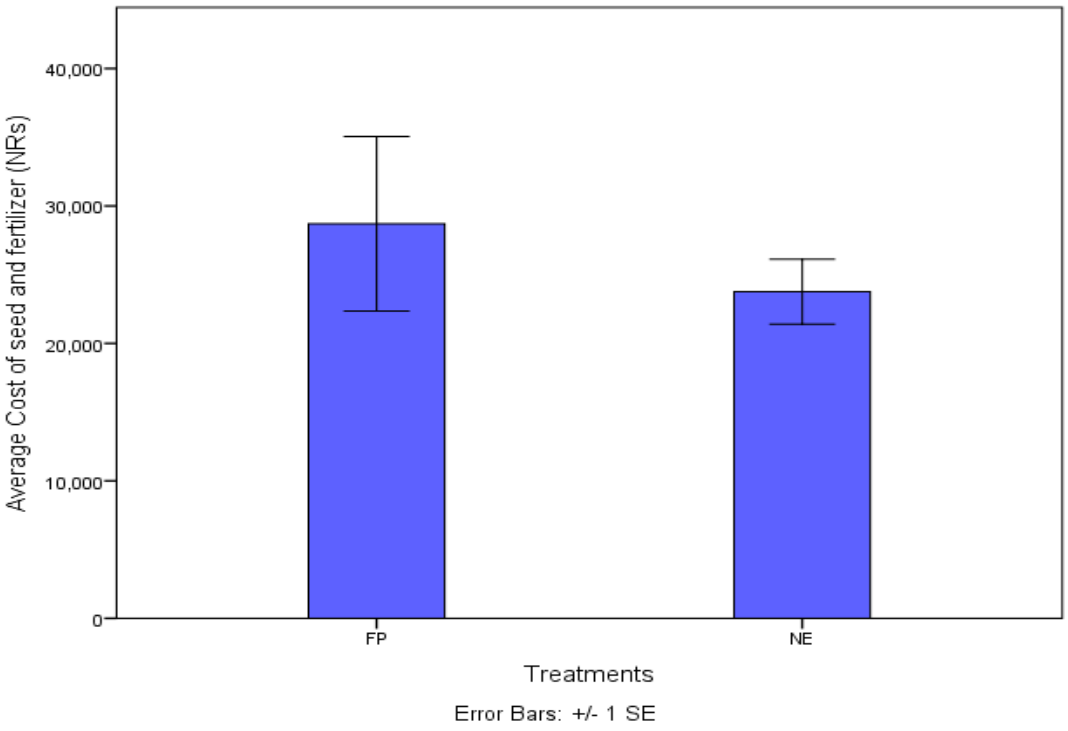
Highly Significant result was found in case of revenue per hector. Revenue from NE field was higher than the FP. Higher revenue was due to higher yield.



FP: Farmer Practice
NE: Nutrient Expert

Figure 6: Average revenue / ha in different treatments given by NE model

4.1.3 Cost of seed and fertilizer (NRs)

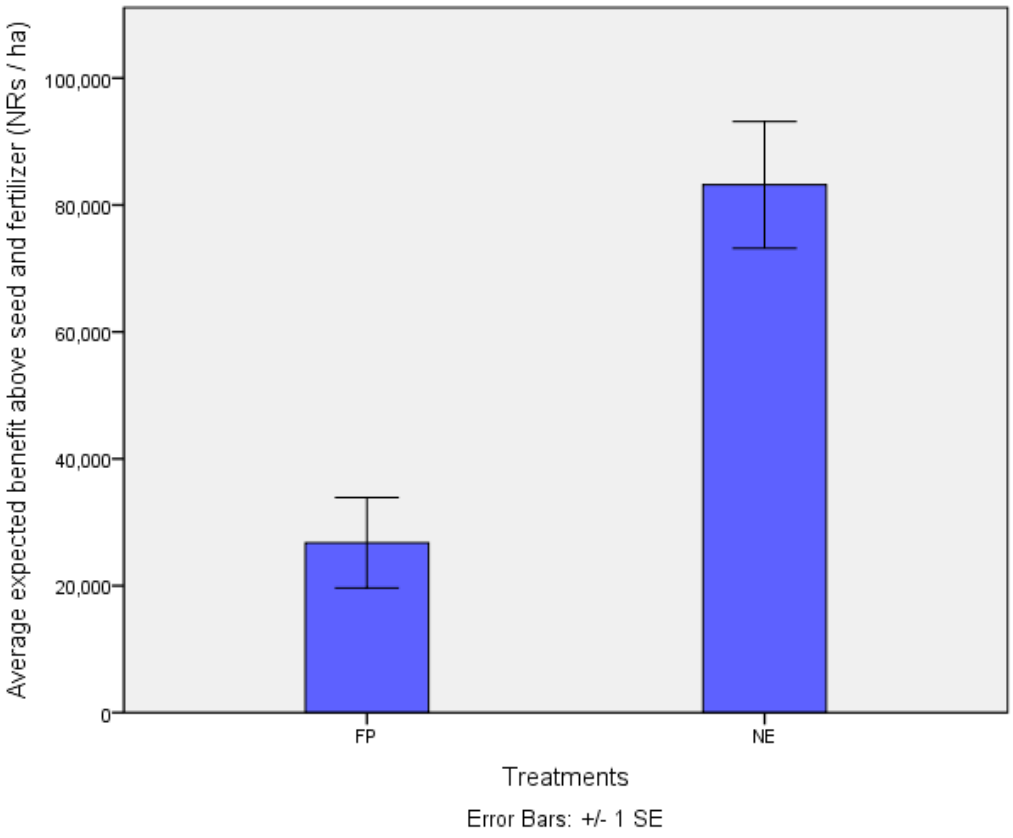


FP: Farmer Practice
NE: Nutrient Expert

Figure 7: Average cost of seed and fertilizer (NRs) with different treatments given by NE model

Non-significant result was found for the cost of seed and fertilizer. Higher yield, and benefit can be obtain from nearly equal cost of seed and fertilizer from NE field.

4.1.4 Expected benefit above seed and fertilizer ha^{-1} (NRs)



FP: Farmer Practice
NE: Nutrient Expert

Figure 8: Average expected benefit above seed and Fertilizer (NRs) in different treatments given by NE model

Highly significant result was found for expected benefit above seed and fertilizer per hector. Simulated benefits above seed and fertilizer from NE field was 3.1 times higher than FP. So, 3.1 times more benefits can be obtained from NE field than FP field from same cost of seed and fertilizer.

4.2 Yield and profitability of maize using Nutrient Expert® Hybrid Maize in field condition

From the trail set up in the farmers field; yield, yield attributes and economics of hybrid maize was obtained. Highly significant result was found for plant no. (m^{-2}), cob no. (m^{-2}), test wt. (g),

yield at 15.5% (t ha^{-1}) and significant result was obtained for avg. no. of kernel/ear, shelling %. Average/plant, length of ear (cm), average no of row/ear is found to be non – significant which is shown below in table 2 and table 3.

Table 3: Yield attributes of maize as affected by nutrient management practices at Jhapa, 12/05/2015-17/05/2015

Treatment	Plant No. (m^{-2})	Cob no. (m^{-2})	Avg. ear $plant^{-1}$	Length of ear (cm)	Avg. no of row ear^{-1}	Avg. no. of kernels ear^{-1}
Farmer Practice (FP)	5.27 [c]	5.45 [c]	1.073	15.438	13.182	30.195 [c]
Gov. Recom. (GR)	6.18 [ab]	6.9 [b]	1.164	15.759	13.636	33.123 [ab]
Nutrient Expert (NE)	6.87 [a]	7.46 [a]	1.3	16.929	13.891	37.324 [a]
SEm (±)	0.35	0.33	0.072	0.575	0.291	1.719
LSD ($P < 0.05$)	1.042**	0.97 **	NS	NS	NS	5.071*
CV %	13.9	20.3	14.3	9.3	4.4	12.7

NS= non-significant; Significant "*"; highly significant "**"

4.2.1 Plant No. per m^2

Highly significant result was found in case of plant no. per m^2. Plant population of NE and GR was found significantly at par and lowest plant population was found in farmer practice. Optimum plant population was found in NE due to recommendation from nutrient expert with proper spacing whereas lowest plant population in FP due to improper seed rate.

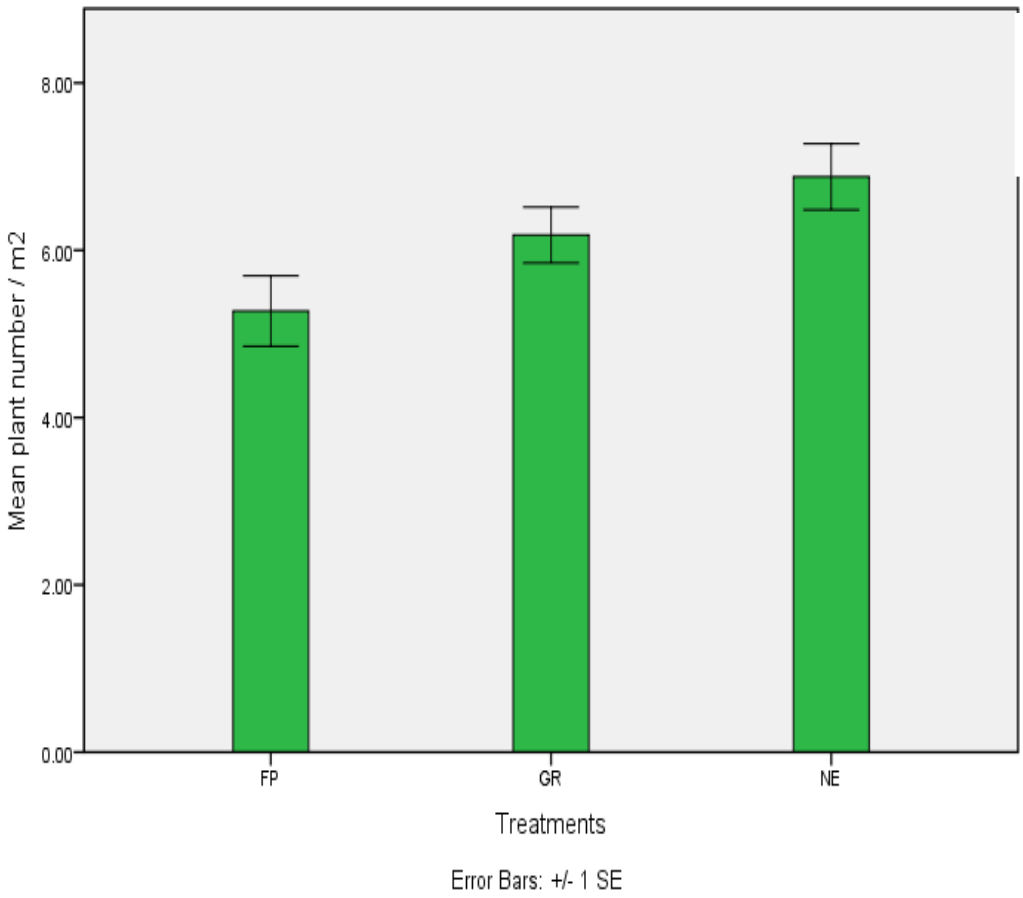
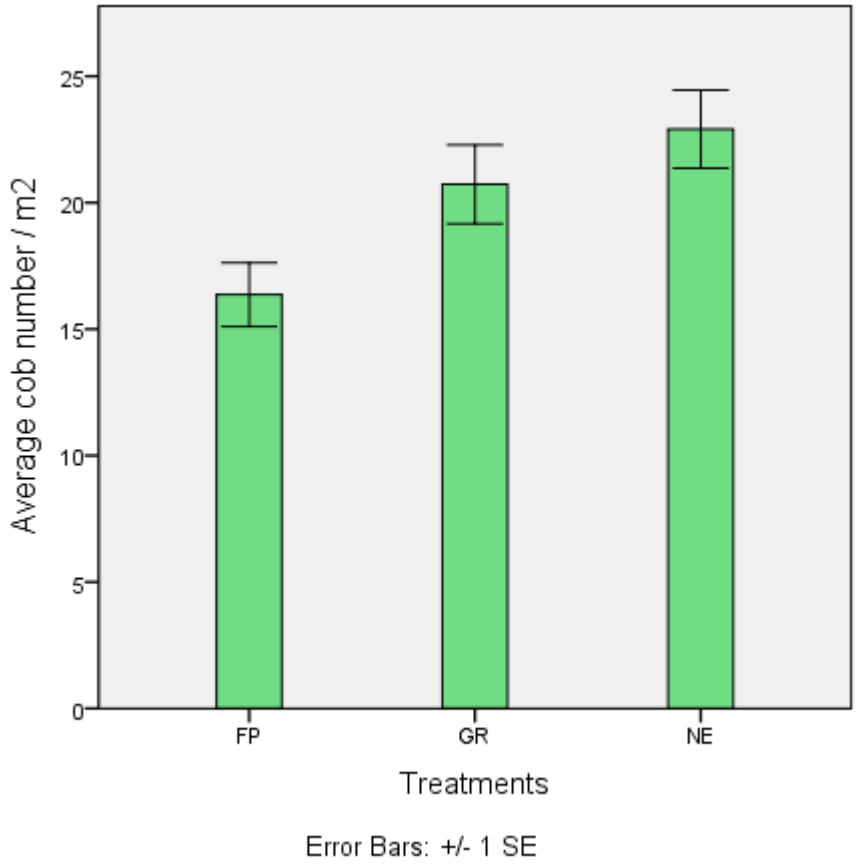


Figure 9: Mean plant number / m^2 in different treatments

4.2.2 Cob No / m^2

Highly significant difference between three different treatments was found in case of cob no. per m^2. Highest cob no. was found in case of NE practice which is followed by GR and FP. Optimum plant population in NE field as compare to other practices results highest cob no.

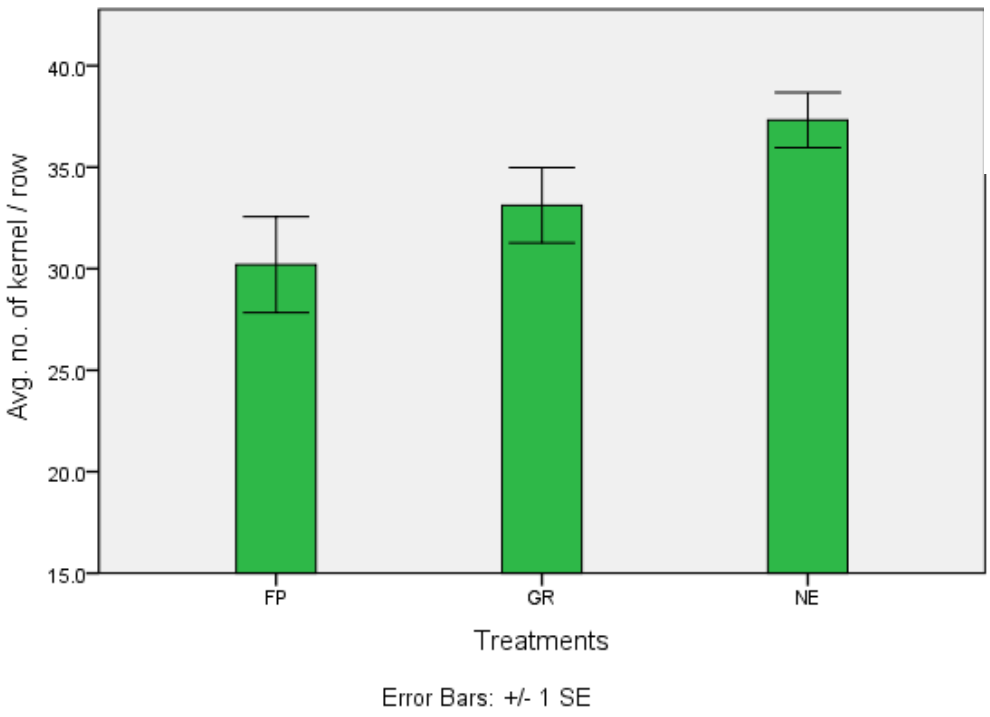


FP: Farmer Practice
GR: Gov. Recommendation
NE: Nutrient Expert

Figure 10: Average cob no. /m^2 in different treatments

4.2.3 Average no. of kernel / ear

Significant difference for average no. of kernel/ rows was observed between three treatments. Kernel/ row was observed significantly at par for NE and GR practices and lowest kernel per row i.e.,(30.2) was observed in FP which result lower yield. Although there is no difference among these three treatments in case of length of ear/ plant but significant difference in kernel no. shows that incomplete grain filling was found in case of FP.



FP: Farmer Practice
GR: Gov. Recommendation
NE: Nutrient Expert

Figure 11: Average no. of Kernel / row in different treatments

4.2.4 Average no. of cob/plant, length of ear/plant and row/ cob

Non-significant difference between three treatments was obtained for average no. of cob per plant, length of ear/ plant and row/ cob.

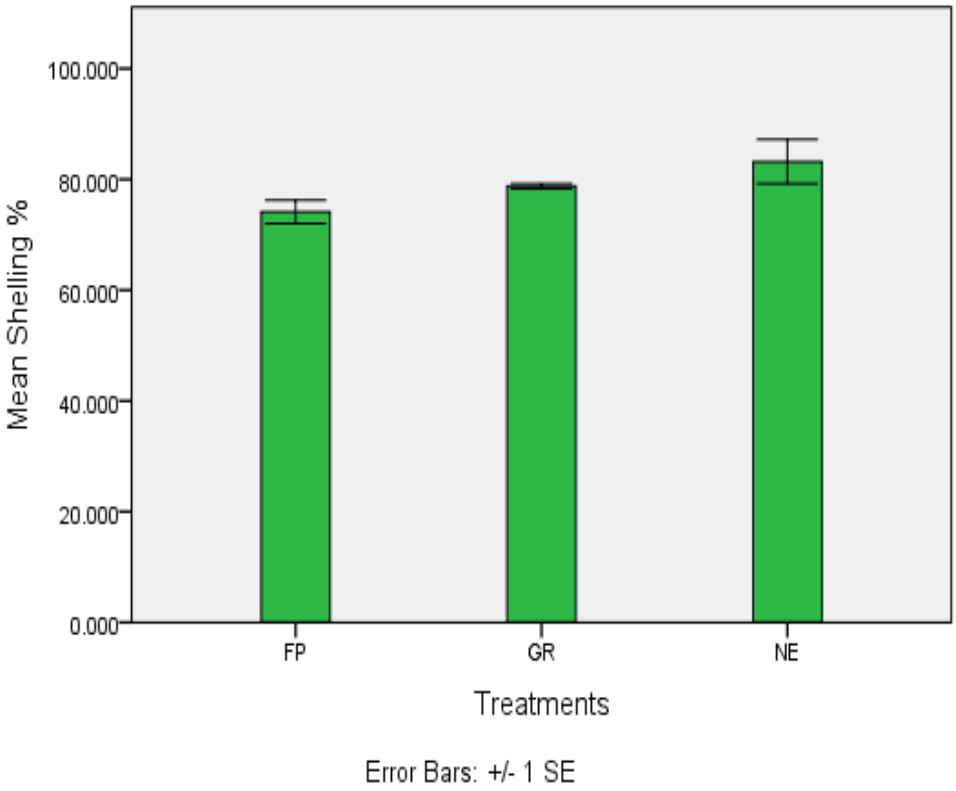
Table 3: Yield, yield attributes and gross revenues of maize due to nutrient management practices in Jhapa, 12/05/2015 - 17/05/2015

Treatment	Shelling%	Test wt.(g)	Yield at 15.5% ($tonha^{-1}$)	Revenue (Rs)
Farmer practice (FP)	74.133[c]	295.45 [c]	7.313 [c]	146259.21[c]
Gov. recommendation (GR)	78.756 [ab]	322.73 [ab]	8.67 [b]	173400.02[b]
Nutrient expert (NE)	83.205 [a]	331.82 [a]	11.99 [a]	239804.26[a]
SEm (±)	2.53	9.24	0.855	17103.9
LSD (P=0.05)	7.46 *	27.26 **	2.523 **	50456.5
CV%	6.7	10.3	26.5	26.5

NS= non-significant; Significant "*"; highly significant "**"

4.3.1 Shelling %

Significant difference between three treatments was found in case of shelling %. Highest shelling % was obtained from NE field cobs i.e., (83.21%). Shelling % of GR was significantly at par with NE. CV% among the same treatment in different replication was 6.7% and LSD value at 0.05 level of significance.



FP: Farmer Practice
GR: Gov. Recommendation
NE: Nutrient Expert

Figure 12: Average shelling % in different treatments

4.3.2 Test weight

Test wt. of grain from was found highly significant. Highest test wt. (331.8 g) was found in NE maize. Test wt. GR (322.7 g) was significantly at par with NE and lowest test wt. was found in FP (295.5 g). Higher the test wt. complements for the higher yield.

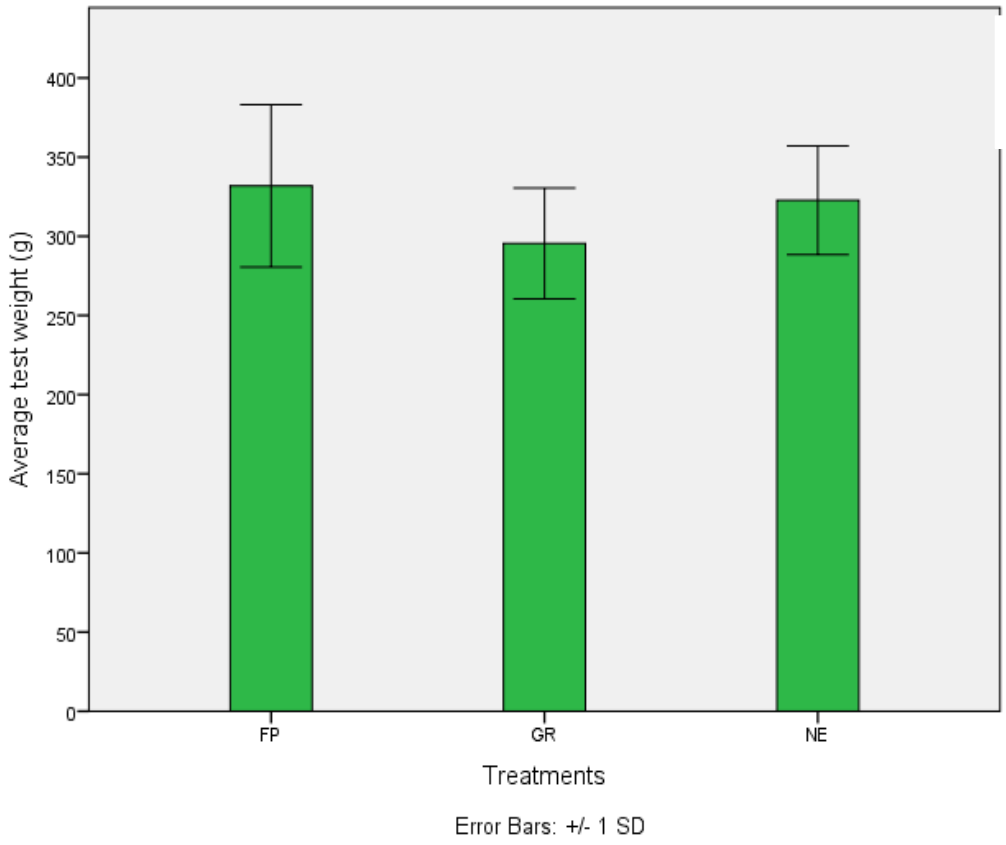


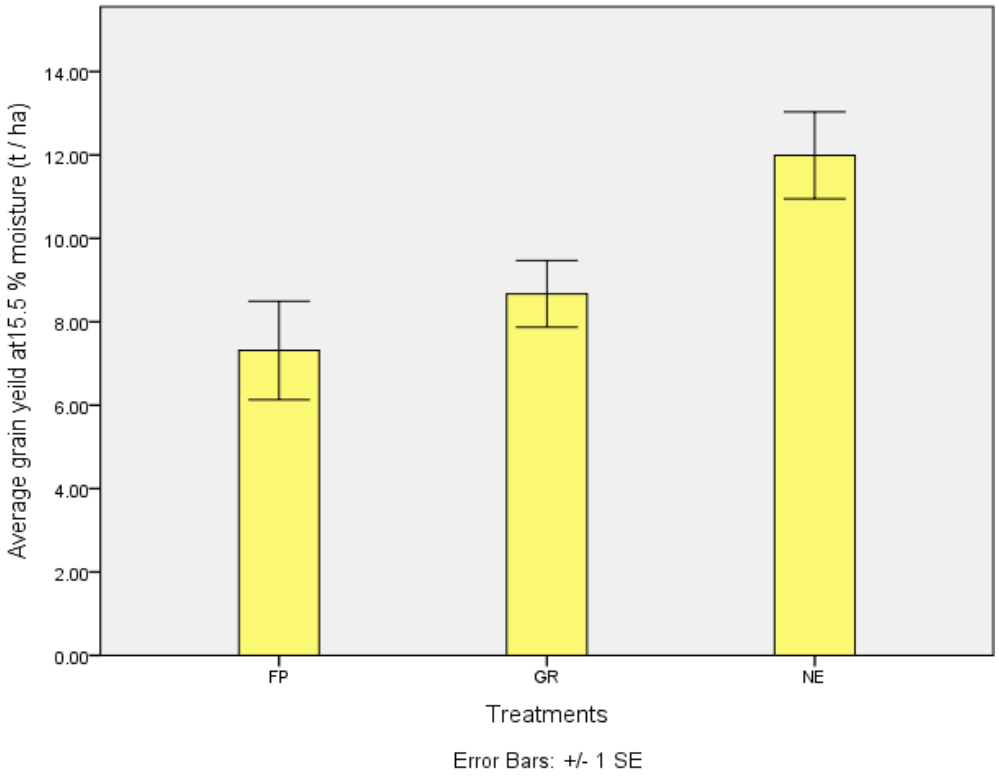
Figure 12: Average test wt. of maize (g) in different treatments

4.3.3 Use of NE increased Yield and economics of hybrid Maize.

Relative performance of NE hybrid maize was found better over GR and FP. Highly Significant result was obtained in yield of hybrid maize. Highest yield i.e., (11.99 ton ha^{-1}) was obtained from NE field which was followed by GR (8.67ton ha^{-1}) and FP (7.31ton ha^{-1}). Highest yield of hybrid maize in NE field was due to higher Plant population, higher cob no per m^2, higher kernel no/row, higher shelling % and higher test wt. which ultimately results in higher yield. Increased in yield and economics was obtained in NE based practice. NE based practices gives (4.68 ton) more yield and (Rs. 93545.05) more gross revenue than FP and (3.32 ton ha^{-1}) more yield and (Rs. 66404.24) more gross revenue than GR.

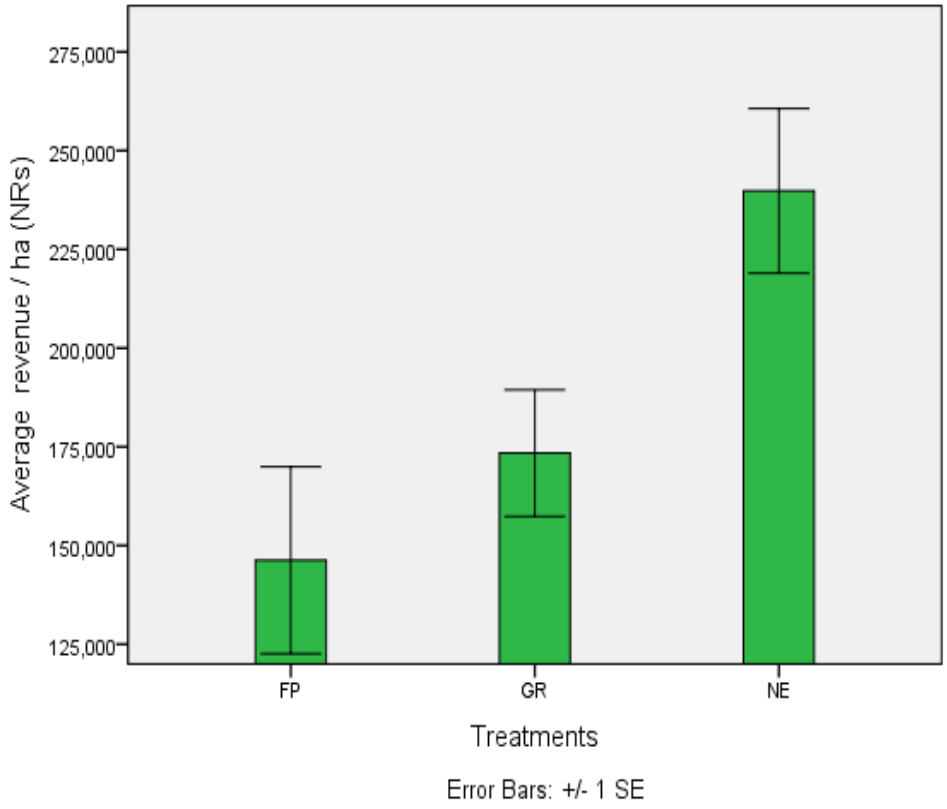
Improved maize yields with the use of NE-based fertilizer recommendations could be attributed to the 4R complaint scientific nutrient prescription generated by NE, which primarily suggests

application of major NPK nutrients using the right fertilizer sources, applied at the right rate and at the right time. NE also suggested application of secondary and micronutrients wherever they were deficient and helped in promoting balanced use of all the essential nutrients in addition to improving yields and optimizing nutrient use (Satyanarayana, 2014). Similar result was found in Indonesia, Philippines, Karnataka and Tamil Nadu of India by providing a nutrient management strategy tailored to field specific condition.



FP: Farmer Practice
GR: Gov. Recommendation
NE: Nutrient Expert

Figure 14: Average grain yield at 15.5 % moisture (t / ha) in different treatments



FP: Farmer Practice
GR: Gov. Recommendation
NE: Nutrient Expert

Figure 15: Average revenue / ha in different treatments

Correlations

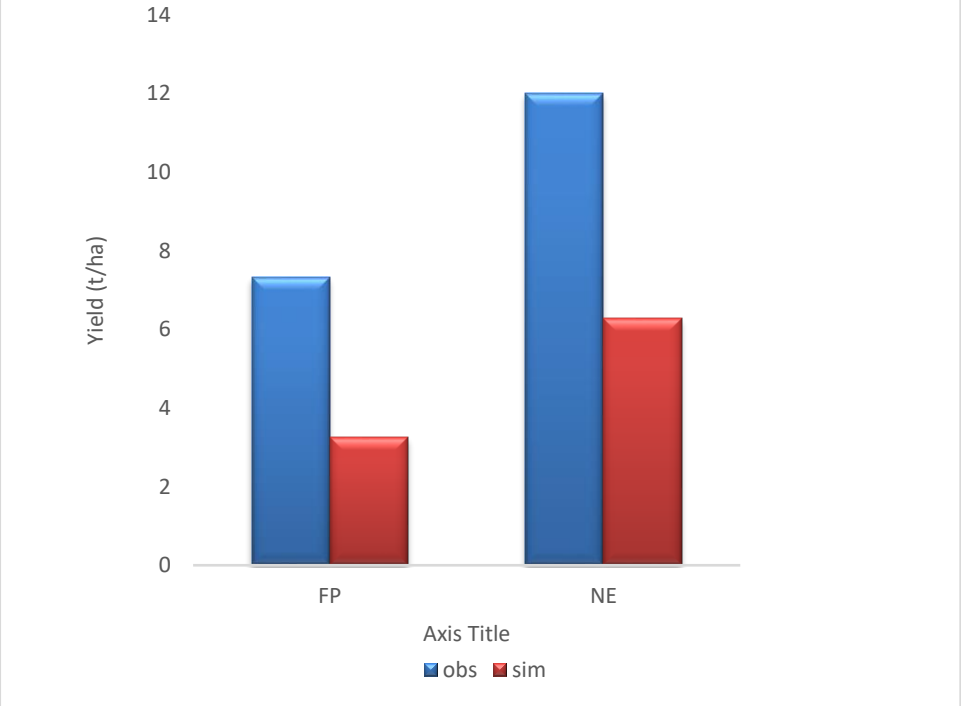
		Yield (t/ha)	No. of plant/m2	No. of cob/m2	No.of kerne/row	Shelling %	Test wt. (g)
Yield (t/ha)	Pearson Correlation	1	.038	.038	.036	.037	.037
	Sig. (1-tailed)		.441	.441	.443	.442	.441
	N	18	18	18	18	18	18
No. of plant/m2	Pearson Correlation	.038	1	.985**	.983**	.998**	.980**
	Sig. (1-tailed)	.441		.000	.000	.000	.000
	N	18	18	18	18	18	18
No.of cob/m2	Pearson Correlation	.038	.985**	1	.938**	.972**	1.000**
	Sig. (1-tailed)	.441	.000		.000	.000	.000
	N	18	18	18	18	18	18
No.of kerne/row	Pearson Correlation	.036	.983**	.938**	1	.993**	.927**
	Sig. (1-tailed)	.443	.000	.000		.000	.000
	N	18	18	18	18	18	18
Shelling%	Pearson Correlation	.037	.998**	.972**	.993**	1	.964**
	Sig. (1-tailed)	.442	.000	.000	.000		.000
	N	18	18	18	18	18	18
Test wt. (g)	Pearson Correlation	.037	.980**	1.000**	.927**	.964**	1
	Sig. (1-tailed)	.441	.000	.000	.000	.000	
	N	18	18	18	18	18	18

**. Correlation is significant at the 0.01 level (1-tailed).

4.3 Evaluation of Nutrient Expert® hybrid maize model

Comparison of Nutrient Expert® (NE) estimated attainable maize yield versus actual maize yield.

For a practical and challenging yield target established by the software under the SSNM Rates module. The comparative figure 4.1 showing the NE-estimated attainable yields and the actual maize yields recorded in the farmer field indicated that NE-based fertilizer recommendations proved to be successful in reaching the yield targets estimated by the software. The NE-estimated average attainable yield target during the Rabi season was 3.26 tonha^{-1}in farmers field 6.27 tonha^{-1} in NE field. The corresponding average actual maize yields realized was 7.31 tonha^{-1} and 11.99 tonha^{-1} indicating that fertilizer recommendations developed using NE successfully helped in meeting the targeted attainable yields. The actual maize yields recorded in farmer fields were higher than the NE estimated attainable yields. Similar results was found in Karnataka state of India between the actual yield on farmer's field and simulated yield by nutrient expert.



FP: Farmer Practice
NE: Nutrient Expert

Figure 16: Comparison of NE estimated attainable yield vs. actual maize

Comparison of Nutrient Expert® (NE) estimated revenue versus actual gross revenue.

From the above table 4.2, we found that higher gross revenue was obtained from both Nutrient Expert and Farmer practice actual field than the simulated gross revenue given by Nutrient Expert® model. Gross revenue of Rs.146259.2 was obtained in actual Farmer practice field and Rs.173400 was obtained in NE field by selling the grain at Rs. 20/kg.

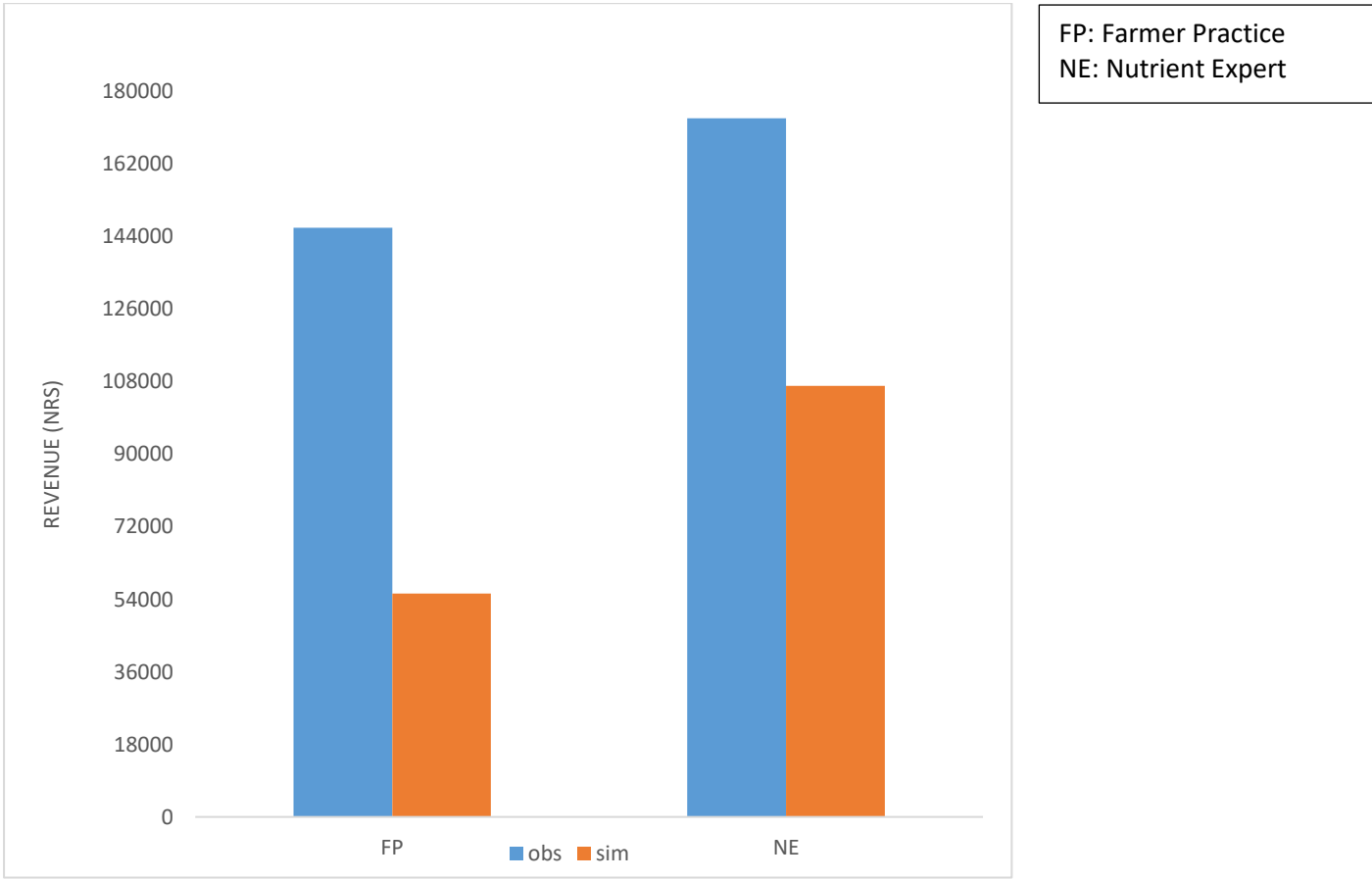


Figure 17: Comparison of NE estimated revenue vs. actual gross revenue

5 SUMMARY AND CONCLUSION

The research was conducted during Nov. 2014 to May 2015 in two VDC of Jhapa viz. Dhukurpani and Gauradha which lies in Damak municipality to see the effect of Nutrient Expert ® based recommendation over Government recommendation and Farmer practices in 11 maize growing farmer field under farmer management during rabi season. Completely Randomized Block Design with 3 treatments and 11 replications (6 replication in Dhukurpani and 5 in Gauradha) was performed. The treatments are FP (Farmer Practice), GR (Government Recommendation) and NE (Nutrient Expert). 33 plot each with the size of 100 m^2 was plotted and all the observation was taken from the net plot of $3m^2$ both NE plot and GR plot were hand weeded first at knee high stage (45 DAS) and 65 DAS followed by earthing up and in FP plot all the intercultural operation were performed according to their practice. All the dose of phosphorus and potash was applied at basal dose and nitrogen was applied at split dose half at basal and half during the knee high stage.

Observation like no of plant/m^2, no of cob/ m^2, average no. of cob/ plant, no. of row/ear, no of kernel/ row, shelling %, grain yield at 15.5%, test wt. was done from the net plot. All the recorded data was tested for homogeneity, normality. And analyzed using IBM SPSS 21 and GEM stat 2003. CV% among same treatment over different replication was calculated. The mean separation was done using LSD value at 5% level of significance.

Highly significant result was obtained for no. of plant/m^2, no. of cob/m^2, test weight, yield at 15.5% moisture and gross revenue. Significant result was obtained kernel no/ear, shelling %. Highest yield i.e., (11.99 $tonha^{-1}$) was obtained from NE plot which was followed by GR (8.67 $tonha^{-1}$) and FP (7.313 $tonha^{-1}$).

Comparison of Nutrient Expert® (NE) estimated attainable maize yield and gross revenue given by Nutrient Expert® hybrid maize model versus actual maize yield and gross revenue in farmer field trail NE-based fertilizer recommendations proved to be successful in reaching the

yield targets estimated by the software. The actual maize yields recorded in farmer fields were higher than the NE estimated attainable yields.

Thus, NE recommendation was found better over GR and FP. Higher yield and profitability from hybrid maize was obtained from NE based recommendation as it make use of the right source of fertilizer ,at right time, in right amount and in right place and fulfilled the growing demand for maize for food and feed.

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APPENDICES

Gannt Chart:

S. N.	Activity	Month																							
		Dec				Jan				Feb				March				April				May			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	
1.	Site selection																								
2.	Soil testing																								
3.	Land preparation																								
4.	Field layout																								
5.	Maize sowing																								
6.	Intercultural operation																								
7.	Irrigation of Maize																								
14.	Maize harvesting																								
15	Data collecton																								
16.	Data analysis and report writing																								

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