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For kind attention of:

The Hon'ble Prime Minister's Office,
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and all others interested

On Critical Policy Issues in India's Agricultural Economy

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Strategies to Bridge Yield Gap of Major Crops in Bundelkhand Region of Madhya Pradesh

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Introduction

- Improving crop yields is essential to meet the increasing demand for food driven by the increasing population and income growth in the 21st century. Increasing agricultural productivity or yield is critical to economic growth and development. It can be achieved by using improved agricultural technologies and applying efficient management techniques. Since, the adoption of techniques differs for every farmer, focus should be on high yielding management practices (Yang et al., 2008)[1], and minimizing yield gaps in major crops by using optimal management practices which may lead to an improvement in production, while offering both environmental benefits and economic value.

- Bundelkhand is a mountain range in central India divided between the states of Uttar Pradesh (U.P.) and Madhya Pradesh (M.P.) with the larger portion in Madhya Pradesh. Bundelkhand comprises of 14 districts: Jhansi, Lalitpur, Jalaun, Hamirpur, Mahoba, Banda and Chitrakoot (in U.P.), and Datia, Tikamgarh, Niwari, Chhatarpur, Panna, Sagar and Damoh (in M.P.). Bundelkhand is a rocky area and has a high percentage of barren and uncultivable land. The soil form is the mixture of black and red-yellow which is not considered very fertile. Rainfall is sparse and the agricultural production is low. Bundelkhand has lost its forest cover to a large extent. So, dependency on forest as a means of livelihood is reducing day by day.

- It seems that the farmers are not able to adopt the recommended package of practices for cultivation of crops due to several socio-economic, technological constraints, etc., resulting into low farm income, high poverty levels which is the main cause of farmers' dissatisfaction.

- The present study was undertaken in all the districts in Bundelkhand region of Madhya Pradesh to analyze the yield gap of major crops grown by the cultivators across sizes of holdings and factors affecting the productivity of these crops. The collection of data and analysis related to interviews was conducted using Computer-Assisted Personal Interviewing (CAPI).

- All the major crops having more than 10 percent share in gross cropped area were selected. Therefore, wheat (27.64%), soybean (16.30%) and gram (14.04%) were considered. Yield gap between the average yield of major crops in the district and average yield of that particular crop was studied. Districts with a higher and a lower yield gap had been selected for each crop. Panna (-43.96%) and Tikamgarh (-19.79%) districts were selected for soybean, while Panna (-43.88%) and Datia (-4.78%) districts were selected for wheat and Chhatarpur (-23.05%) and Damoh (-4.04%) districts were selected for gram for this study.

- A block in each district was further selected on the basis of the highest area under the crop. A list of all the villages in each selected block was prepared and three villages having maximum area under cultivation of the crop were selected for the study. A list of all the cultivators growing the selected crop was further prepared and

1 Yang, Woonho & Peng, Shaobing & Laza, M. R. & Visperas, Romeo & Dionisio-Sese, Maribel (2008). Yield Gap Analysis between Dry and Wet Season Rice Crop Grown under High-Yielding Management Conditions. Agronomy Journal- AGRON. 100. 10.2134/agronj2007.0356.

classified into small (area<2 ha), medium (2-5ha) and large (>5ha) categories and 10 farmers in each category were selected randomly. A total of 180 farmers-30 each from districts with high and low yield gap were selected for all the crops in the study.

Findings

- Maximum yield gap between the potential and average farm yield (yield gap III) was found in cultivation of gram (43.59%) followed by soybean (38.87%) and wheat (29.86%). The yield gap II (highest farm yield-average farm yield) was found to be more than yield gap I (potential farm yield-highest farm yield) in cultivation of wheat, gram and soybean (see Table 1). It is understood that the Recommended Package of Practices (RPP) for cultivation had reached the field but farmers could not adopt these technologies due to unavailability of desired variety of seeds, high cost of inputs, lack of knowledge about the dose of fertilizers as per soil test recommendation, the method of seed treatment. Table 1 given below shows the yield gap analysis for various crops.

Table 1: Yield Gap Analysis (quintals/acre)

Particulars	Wheat	Gram	Soybean
Potential Yield (A)	23	8	10
Average Yield (B)	16.13	4.51	6.11
Highest Yield (C)	20.31	6.5	8.86
Yield gap-I (A-C)	2.69	1.5	1.14
	(11.68)	(18.79)	(11.43)
Yield gap-II (C-B)	4.18	1.98	2.74
	(20.29)	(30.49)	(30.85)
Yield gap-III (A-B)	6.87	3.49	3.89
	(29.86)	(43.59)	(38.87)

Source: *Survey*. ***Note:*** *Figures in parenthesis shows percentage difference*

- Low germination of soybean seed (70%) was reported as the major constraint in the study area. The respondents also reported the unavailability of capital, electricity and labor during the peak cultivation season.
- A multiple regression model was run to find out determinants for yield of major crops and was found to be a good fit as it explained more than 80 percent contribution of known independent variables. The crop response in terms of productivity with respect to independent variables like use of High Yielding Varieties (HYVs), improved method of sowing, seed replacement (purchase seed), consumption of fertilizers as per soil test recommendation, proper seed rate, increased consumption of Di-Ammonium Phosphate (DAP) fertilizer was found to be positive while age (in years) was found to be negative.

Table 2: Determinants of Yield of Major Crops (Regression Coefficients b1 to b12)

Particulars	Coefficients		
	Wheat	Gram	Soybean
"a" value	621.68 (0.1235)	251 (0.0003)	122.24 (0.9440)
Education (X1)	-0.0541 (0.6057)	37.2378 (0.0401)	11.0281 (0.0652)
Age in years (X2)	-0.0181 (0.2831)	-1.6908 (0.2684)	-1.2299 (0.1439)
Source of Seed (X3) (Purchase-1, Self-0)	1.0517* (0.0213)	49.2581 (0.1990)	103.7147 (0.0839)
Soil Test (X4) (Yes-1, No-0)	1.5739** (0.0001)	42.1450 (0.3040)	53.5092 (0.5784)
Seed Rate (kg) (X5)	0.0262** (0.0000)	31.1188** (0.0051)	3.8736* (0.0353)
Seed Treatment (X6) (Yes-1, No-0)	-0.2309 (0.5528)	106.4320* (0.0252)	29.8112 (0.5238)
Use of HYV's Seed (X7) (HYVs-1, Local-0)	0.3258 (0.4659)	154.4361** (0.0031)	81.8860* (0.0226)
Urea (kg) (X8)	0.0274* (0.0498)	35.4693** (0.0015)	-0.5941 (0.9087)
DAP (kg) (X9)	0.0469 (0.1014)	2.3281 (0.4938)	5.7391** (0.0094)
Area under Irrigation (X10)	0.1172 (0.0955)	63.8487* (0.0274)	51.0759** (0.0036)

Particulars	Coefficients		
	Wheat	Gram	Soybean
Size of Holding (X11)	-0.1079* (0.0309)	1.5688 (0.2583)	-32.4088** (0.0077)
Method of Sowing (X12) (Line sowing=1 & Broadcasting=0)	-	-	203.5692 (0.0647)
Estimates	116.34	117.63	73.61
R^2 (Coefficient of Multiple Determinates)	0.855	0.839	0.839

Note: ** & ** significant at 5 (P<0.05) & 1 (P<0.01) percent, respectively. Figures in parenthesis show P-value.*

- In the table 2 given above, X1 through X12 are the Independent Variables. The regression coefficients b1 through b12 can be studied for wheat, gram and soybean.
- The response of wheat in term of productivity with respect to soil test based application of fertilizer and use of proper seed rate was found to be positive and highly significant, use of purchased seed and consumption of urea were found to be positive and significant while size of holding was found to be negative and significant.
- In case of gram, independents variables like use of HYVs seed, seed treatment, area under irrigation, increase of a kg of urea and proper seed rate would be able to enhance yield of gram to 154, 106, 63, 35 and 31 kg per acre respectively.
- In case of soybean, use of HYVs seed, proper seed rate, increased area under irrigation and one kg increase in DAP per acre would be able to enhance yield of soybean to 81.88, 3.87, 51.07 and 5.74 kg per acre respectively, while increase in one-acre size of holding would be able to decrease yield of soybean with 32.41 kg per acre.

Conclusion and Recommendations

- It was found during the course of investigation that majority of sample respondents did not adopt need based Integrated Farming System (IFS) efficiently, efforts could be made to introduce it. At least one seed producer company, custom hiring center could be established in every gram panchayat/development block of Bundelkhand Region of Madhya Pradesh.
- It was observed that the 'Toll Free number' of the Kisan Call Centre (1800-180-1551) had not yet become the main source of information dissemination to the farmers in the area under study. Hence, strategies could be made to ease access to the farmers so that they could solve their problems related to crop and animal husbandry.
- Need based training programmes on RPP for cultivation of crops must be organized in the nearest Krishi Vigyan Kendra (KVK) for the field staff of the Department of Farmers Welfare and Agriculture Development, Madhya Pradesh followed by producers before the start of the season. The training must be designed for the field staff and producers in such a way that it directly aids the crop productivity.
- Technology adoption in agriculture is a long drawn process, which involves developing appropriate need-based technology, testing the new technology, taking it from lab-to-land, and optimum application of it for obtaining the desired benefit. The new technology needs to be integrated within the existing system and policies for wider acceptability. Technology demonstrations could be shown in villages to popularize RPP for cultivation of crops. If there is an incidence of insects or disease, a field day could be organized for all the farmers of the village to help them to learn through observation.

- Since majority of farmers reported that unavailability of desired variety of seed was a major constraint in the cultivation of crops, an online portal on seed distribution could be created by the government to show the variety and class-wise availability of seeds with the facility of online purchase/booking.
- Digital technology requires the use of computers, internet, mobile technology, application tools, etc. It may not be easy for majority of farmers with their current level of education, exposure and remoteness to use it properly and appropriately. To certain extent, capacity building on the principle of demonstration could be adopted to motivate farmers to accept technological change in agriculture.
- There is also a need of Public Private Partnership (PPP) for knowledge management and procurement of produce at reasonable prices which works as a catalytic agent for increasing adoption of crop production technologies leading to breaking yield barriers in crop production.

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Market Imperfections and Farm Profitability in Gujarat

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Introduction

- Profitability is an important economic motivator for the farmers to take up sustainable agricultural practices. As farming in India is characterized by small and fragmented land holdings, disguised unemployment, uncertainties and high dependence on monsoon rains, profitability in farming still needs to be worked upon. The economic viability depends on input costs, institutional framework and different government policies.
- Agrarian distress is not only limited to rain fed areas but also spread to progressive states like Punjab and Kerala where the new generation of farm households is distantly interested in farming. Agriculture needs to be made more profitable, attractive and enterprising so that the rural to urban migration could be reduced and farmers take pride in their profession, which can only happen if bottlenecks are removed.
- Understanding of agricultural input and output market is essential for improving agricultural productivity and growth because farmers cannot be motivated to increase yield if they are unable to sell their produce. If this occurs, it defeats the objective of intensifying agricultural production as the majority of the population derives its livelihood from agriculture.
- Recent efforts to improve farmers' income have been focused on raising Minimum Support Prices (MSPs). Historical evidences show that MSP does not directly translate into higher income for farmers due to a deficient and ineffective implementation framework. Additionally, high MSPs result in market distortions and render Indian exports uncompetitive in world markets. Realizing the need to pay special attention to the plight of the farmers, union government changed the name of Ministry of Agriculture to Ministry of Agriculture and Farmers' Welfare in 2015.
- One of the important ways to achieve the government's goal of doubling farmers' income by the year 2022 could be by reducing agrarian