First year results from the diversified cropping pattern platform trial hosted by BWMRI in Dinajpur, Bangladesh

Mohammad Washiq Faisal, CIMMYT; Akbar Hossain, BWMRI; Stephanie Cheesman, CIMMYT

OBJETIVE

This study is part of TAFSSA, an integrated CGIAR initiative emphasizing on farm- and landscape-level interdisciplinary research to identify strategies to increase farmers' profits and nutritional yields, conserve resources, and maintain or enhance ecological services, while also mitigating greenhouse gas emissions. The platform trial in particular compares diversified cropping patterns beyond their agronomic benefits; that is: looking at nutritional yields, profitability as well as environmental impact variables.

Table 1: Description of the diversified cropping patterns compared and first year results for rice equivalent yield (t/ha).

Treatment	Diversification options	Cropping pattern	Rice Equivalent Yield (t/ha)				
			*Kharif-2**	*Rabi*	*Rabi* veg**	*Kharif-1*	TOTAL
T1	Business as usual - 1	*Aman* - fallow - *Boro*	5.44	8.84	-	-	14.28
T2	Business as usual - 2	*Aman* - Maize - fallow		7.45	-	-	12.89
T3	Profitability & improved nutrition	*Aman* - Potato - Sweetcorn		7.59	-	9.95	22.98
T4	Increased production & improved nutrition	*Aman* - Coriander - *Boro*		9.78	1.22	-	16.44
		Aman - Spinach - *Boro*		9.78	failed	-	15.22
		Aman - Napa shak - *Boro*		9.78	6.38	-	21.60
		Aman - Lal shak - *Boro*		9.78	3.52	-	18.74
T5	Increased production & improved nutrition	*Aman* - Maize+Coriander - Sorghum		7.39	2.31	3.16	18.30
		Aman - Maize+Spinach - Sorghum		7.39	failed	3.16	15.99
		Aman - Maize+Napa shak - Sorghum		7.39	3.85	3.16	19.84
		Aman - Maize+Lal shak - Sorghum		7.39	1.32	3.16	17.31
T6	Diversified production	*Aman* - Mustard (canola) - Groundnut		2.60	-	9.14	17.18
T7	Diversified production & improved nutrition	*Aman* - Carrot – Maize		7.15	-	7.38	19.97
T8	Profitability & soil health	*Aman* - Wheat - Jute		5.41	-	5.42	16.27
T9	Diversified production & soil health	*Aman* - Soybean* - Mustard - Maize		3.23	-	7.61	16.28

N.B. *Aman* refers to rice grown in the *Kharif-2* season; while *Boro* refers to rice grown in the *Rabi* season.
* In the first *Kharif-2* season, established in August 2022, each replicate was split lengthwise into two strips (8.5 m x 110 m) and two biofortified rice varieties (BINA 20 and BRRI 72) were grown; only the BINA 20 yield is reported here; T9 was *Aman* in this first season and not Soybean. ** Leafy vegetables added before *Boro* in T4 and intercropped with Maize in T5.

METHODS

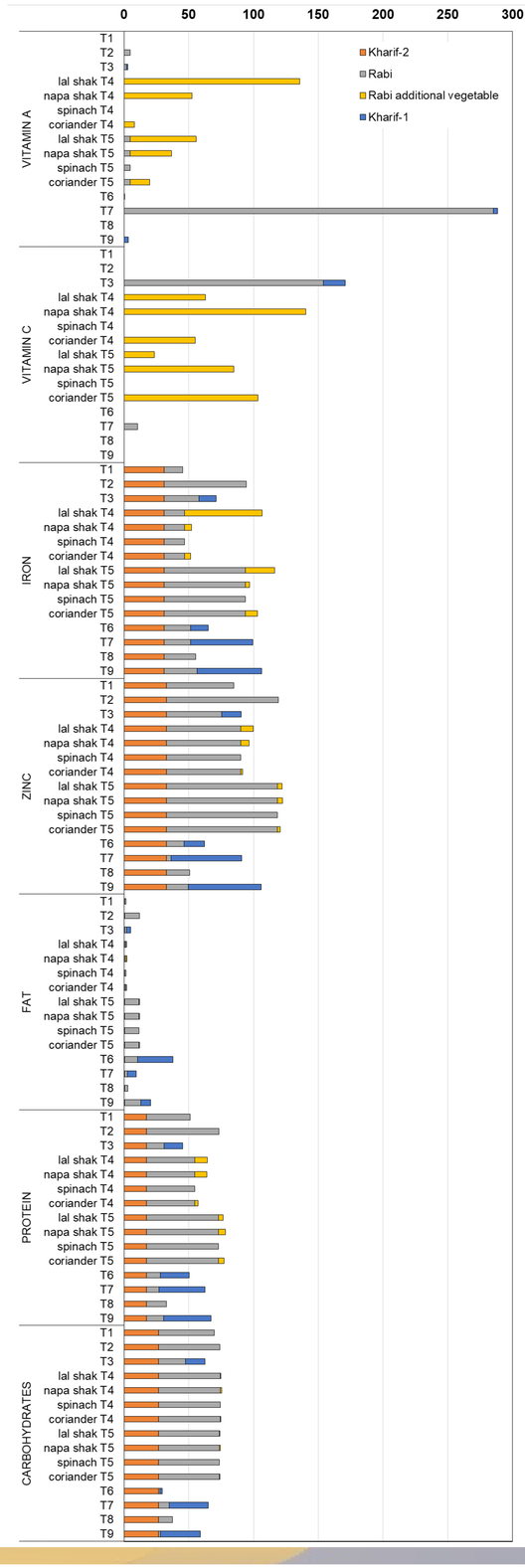
- This Research Platform Trial is hosted at the Bangladesh Maize and Wheat Research Institute (BWMRI) in Dinajpur; GPS coordinates: 25.742715, 88.672334.
- The trial follows a randomized complete block design (RCBD), with 9 treatments (Table 1) replicated 3 times. Net plot size is 17m x 11.5m. Treatments 4 and 5 includes split plots for different leafy vegetables (spinach, red amaranth (lal shak), coriander and napa shak).
- Agronomic data, all above ground biomass crop production, costs of all inputs incl. labor and amount of irrigation water applied are among the data collected.
- To compare yields of different crops, rice equivalent yield (REY) is calculated.

  REY (t/ha) = Yield of non-rice crop (t/ha) x price of non-rice crop / price of rice
- Nutritional yields for major nutrients, Iron (Fe) and Zinc (Zn) as well as Vitamin A and C are calculated as described by DeFries et al. (2015).
- Profitability is assessed by calculating "net income" for each crop separately using the following formula:

  Net income (US$/ha) = Yield (t/ha) * market price ($/t) – sum of all production costs ($/ha)

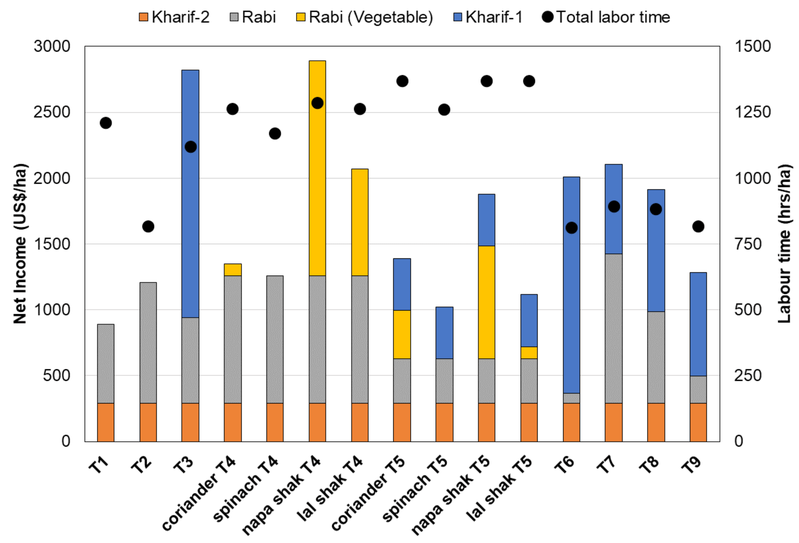
  The production costs considered are seed, fertilizer, irrigation, pesticides / insecticides / herbicides used and labor for all operations; not taken into account is land rent, which for farmers can be substantial.

Figure 1: Nutritional yields (no. of adults / ha and year) by cropping patterns for major nutrients (carbohydrates, fat, proteins), minerals (Iron, Zinc) as well as Vitamin A and C.



Definition: The nutritional yield of a specific nutrient refers to the number of adults who can fulfil 100% of their recommended dietary refence intake of that nutrient for an entire year from the produce of one hectare land.

Figure 2: Net Income (US$/ha) and total labor time (hrs/ha) by cropping pattern.



RESULTS

The findings presented here are the result of one year, a full cropping cycle. These first results, show clear differences in terms of productivity, nutritional yields and profitability. It is however too early to draw conclusions; multiple year data are needed.

- Comparing the traditional rice-fallow-rice (T1) to a slightly diversified rice-leafy vegetables-rice (T4) rotation we observe a clear increase in nutritional yields, especially for vitamins and iron; however, REY increase is variable, and profitability is heavily dependent on which leafy vegetables is grown. Labor needs are only slightly increased when adding a leafy vegetable between the two rice seasons.
- Looking at the second most common cropping patter rice-maize-fallow (T2) as compared to rice-maize intercropped with leafy vegetables- sorghum (T5) the nutritional yield again is improving owing to the additional vegetable crop; however, total REY decreases as maize yields are negatively affected by the intercrop; profitability is again heavily dependent on which leafy vegetables is grown. Labor needs are strongly increased in T5 as compared to T2.
- Sweetcorn, Groundnut and Carrot have a reasonable high market value, however from on-farm work (within the same research initiative) the need to address market system development has been highlighted by farmers.
- Net income was calculated using fixed local market prices, in reality the prices for vegetables are highly variable even within a cropping season a this needs to be factored in.

REFERENCES

DeFries, R., Fanzo, J., Remans, R., Palm, C., Wood, S., Anderman, T., 2015. Metrics for land-scarce agriculture: nutrient content must be better integrated into planning. Science 349, 238–240.