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NUTRITIONAL ANALYSIS REPORT. PROJECT IN BURUNDI

1. BACKGROUND

Back in 2022, 23 sets of Solar Milling systems with Zebra mills were installed in Eastern and North regions in Burundi.

Beneficiaries are small towns mostly off-grid, using diesel engine driven or grid connected mills when possible. High prices of fuel and unreliable power supply was very often a constraint for milling service to the community.

Zebra mill driven entirely by solar energy are installed now close to the end users, also avoiding long walking distances.

Due the innovation of having a screenless mill like the Zebra solar powered mill model, an in-situ training was performed in several locations to operate and maintain the systems.

Flour quality was accepted from families, also to feed young children. Mill can produce very fine or coarser flour with minimum action, due no accessories must be changed. In all the cases, flour obtained is considered whole flour.

2. PURPOSE

- To Compare macro and micronutrients contents in flours from different grains grinded in 2 different ways: screen through by a traditional mill, and without screen as it is the Zebra solar powered mill by Solar Milling company.
- To calculate the extraction rate for each grain sample, to determine output returned to final customer.

3. REPORT DATA

- Locations: Ruyigi and Rutana areas. Republic of Burundi.
- Grains collection date: October 5th, 2023.
- Milling and flour collection date: October 6th, 2023.
- Laboratory delivery date: October 18th, 2023. Spain.
- Analysis completion date: December 5th, 2023.
- Raw grains purchased in the local market: Soybeans, Maize, Rice, Sorghum and Wheat.

- Each type of grain was weighed two times in 1 kg and grinded separately in 2 different types of mills.
    - Regular mill, very common in rural areas. Driven by electric motor 7.5 kW or bigger. Grid or generator powered. With sifter and screen.
    - Solar mill Zebra. Driven by 2.2 kW electric motor. Powered by solar energy. No screen, no sifter. Whole grain flour.

- Finest flour obtained by both milling systems are around 500 microns and accepted by final users.
- Resultant flour was collected and weighed again to determine the extraction rate (see table)

SAMPLE	TYPE DE GRAIN	EXTRACTION PER KG	EXTRACTION (%)	*GRAIN MOISTURE (%)
REGULAR MILL WITH SIFTER AND SCREEN – ELECTRIC DRIVEN				
1	Soybean	680 gr	68%	7,90%
2	Maize	750 gr	75%	12,7%
3	Rice	910 gr	91%	13%
4	Sorghum	815 gr	82%	15,5%
5	Wheat	900 gr	90%	13,3%
ZEBRA MILL WITHOUT SCREEN – SOLAR PV DRIVEN				
6	Soybean	1000 gr	100%	7,90%
7	Maize	1000 gr	100%	12,7%
8	Rice	1000 gr	100%	13%

9	Sorghum	1000 gr	100%	15,5%
10	Wheat	1000 gr	100%	13,3%

* Measured with WILE55 Moisture meter

4. MACRO AND MICRONUTRIENTS COMPARISON TABLE

Laboratory: Analiza Calidad SL. Spain. ISO 9001:2015 and ISO 17025 certified.

SOYBEANS FLOUR		
	REGULAR MILL	ZEBRA MILL
Extraction rate	68%	100%
Moisture in flour	8,4%	6,7%
MACRONUTRIENTS AND MICRONUTRIENTS		
Energy value (Kcal/100g)	310	384
Energy value (KJ/100g)	1306	1606
Protein (%)	31,5	38,1
Monounsaturated fat (%)	0,34	3,27
Saturated fat (%)	0,25	2,45
Polyunsaturated fat (%)	0,83	8,14
Fat sum (%)	1,43	13,9
Carbohydrates (%)	4,72	17,5
Total sugars (% glucose)	5,17	6,23
Total dietary fibre (%)	19,1	18,3
Calcium (mg/kg)	1800	2500
Magnesium (mg/kg)	2100	2100
Iron (mg/kg)	93	110
Zinc (mg/kg)	40	49
Phosphorus (mg/kg)	0,52	0,42
Potassium (mg/kg)	1,4	1,6
Vitamin C (µg/kg)	<100	<100
Vitamin K (µg/100g)	18,1	31
Vitamin B9 (µg/kg)	100	180

MAIZE FLOUR		
	REGULAR MILL	ZEBRA MILL
Extraction rate	75%	100%
Moisture in flour	12%	9,97%
MACRONUTRIENTS AND MICRONUTRIENTS		
Energy value (Kcal/100g)	333	357
Energy value (KJ/100g)	1410	1509
Protein (%)	9,49	11,33
Monounsaturated fat (%)	0,32	1,18

Saturated fat (%)	0,2	0,72
Polyunsaturated fat (%)	0,55	2,17
Fat sum (%)	1,08	4,09
Carbohydrates (%)	70,2	64,6
Total sugars (% glucose)	1,72	2,18
Total dietary fibre (%)	6,93	8,45
Calcium (mg/kg)	79	120
Magnesium (mg/kg)	1000	1000
Iron (mg/kg)	27	69
Zinc (mg/kg)	20	21
Phosphorus (mg/kg)	0,26	0,32
Potassium (mg/kg)	3600	4300
Vitamin B3 (µg/kg)	3090	4890
Vitamin B5 (µg/kg)	N/D	N/D
Vitamin B9 (µg/kg)	4	67

RICE FLOUR		
	REGULAR MILL	ZEBRA MILL
Extraction rate	91%	100%
Moisture in flour	11,1%	11,2%
MACRONUTRIENTS AND MICRONUTRIENTS		
Energy value (Kcal/100g)	354	345
Energy value (KJ/100g)	1503	1463
Protein (%)	8,9	13,67
Monounsaturated fat (%)	0,1	0,23
Saturated fat (%)	0,31	0,22
Polyunsaturated fat (%)	0,34	0,55
Fat sum (%)	0,85	1,01
Carbohydrates (%)	79,5	71,1
Total sugars (% glucose)	0,5	1,47
Total dietary fibre (%)	1	2,74
Calcium (mg/kg)	33	190
Magnesium (mg/kg)	10	18
Iron (mg/kg)	0,02	22
Zinc (mg/kg)	14	23
Phosphorus (mg/kg)	0,14	0,24
Potassium (mg/kg)	730	3500
Vitamin B3 (µg/kg)	5640	22850
Vitamin B5 (µg/kg)	2484	13465
Vitamin B9 (µg/kg)	100	300

SORGHUM FLOUR		
	REGULAR MILL	ZEBRA MILL
Extraction rate	82%	100%
Moisture in flour	12,5%	10,9%
MACRONUTRIENTS AND MICRONUTRIENTS		
Energy value (Kcal/100g)	345	350
Energy value (KJ/100g)	1461	1482
Protein (%)	7,91	8,96
Monounsaturated fat (%)	0,6	0,89
Saturated fat (%)	0,32	0,46
Polyunsaturated fat (%)	0,79	1,16
Fat sum (%)	1,71	2,54
Carbohydrates (%)	72,3	69,5
Total sugars (% glucose)	1,52	1,05
Total dietary fibre (%)	4,16	6,72
Calcium (mg/kg)	55	43
Magnesium (mg/kg)	17	15
Iron (mg/kg)	33	36
Zinc (mg/kg)	19	17
Phosphorus (mg/kg)	0,21	0,29
Potassium (mg/kg)	3400	3100
Vitamin B3 (µg/kg)	3090	9470
Vitamin B5 (µg/kg)	N/D	N/D
Vitamin B9 (µg/kg)	56	215

WHEAT FLOUR		
	REGULAR MILL	ZEBRA MILL
Extraction rate	90%	100%
Moisture in flour	12,4%	10,9%
MACRONUTRIENTS AND MICRONUTRIENTS		
Energy value (Kcal/100g)	329	336
Energy value (KJ/100g)	1396	1422
Protein (%)	9,95	10,74
Monounsaturated fat (%)	0,22	0,1
Saturated fat (%)	0,26	0,42
Polyunsaturated fat (%)	0,6	1,08
Fat sum (%)	1,08	1,77
Carbohydrates (%)	68,3	63,7
Total sugars (% glucose)	2,41	2,3
Total dietary fibre (%)	8,28	11,4
Calcium (mg/kg)	120	130

Magnesium (mg/kg)	750	1000
Iron (mg/kg)	63	100
Zinc (mg/kg)	20	26
Phosphorus (mg/kg)	0,23	0,28
Potassium (mg/kg)	2900	3500
Vitamin B3 (µg/kg)	2600	17130
Vitamin B5 (µg/kg)	923	10096
Vitamin B9 (µg/kg)	17	25

5. CONCLUSIONS

1) Analysis tables shows a significant difference in minerals and vitamins contents. Those are normally in the grain bran layer and germ, also in endosperm. Full extraction Zebra mill assures that flour contains all nutrients that a healthy body needs and even more relevant fact in diets with cereals as staple food.

   Zebra mill was developed to match with solar power but also to enhance the nutrition in populations with scarce diet variety, with special mention to children.

2) Installation of Solar Milling systems as a productive use of renewable energy (PURE) is proven effective in rural areas off-grid or weak power supply. Operating mills at zero cost pushes local economy, avoid pollution and dependance on fuel supply.

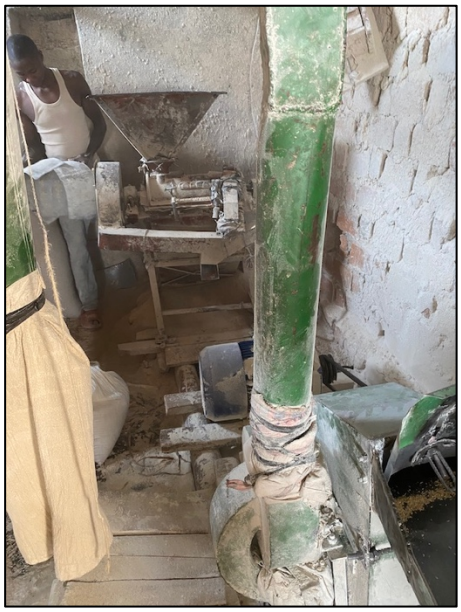
3) The use of a screenless grinding system like Zebra mill, provides full extraction from the hard-to-get cereals. It reduce dramatically post-harvest losses and mean more benefit for the farmers.

4) Flour analysis was conducted to point out one of the most relevant highlights, the fight against the hidden hunger and to improve the food value chain.

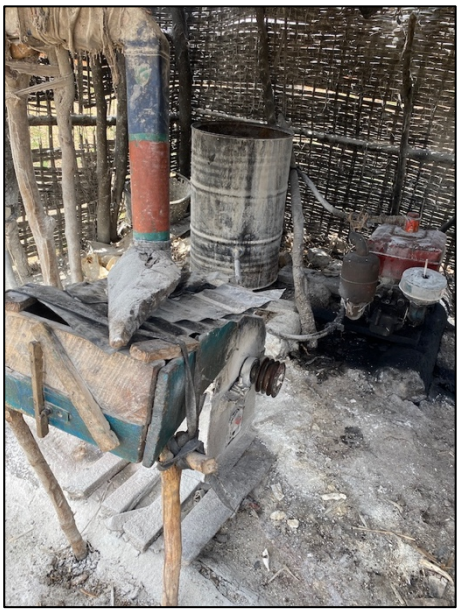
5) Having a system easy to use, with nutritional benefits, close to users and ecological, might reduce rural exode, improve food security and food sovereignty.

6) The fact of having a grinding mill driven by solar energy, with full extraction and more macro and micronutrients contents in flour should be considered as suitable.

6. PICTURES

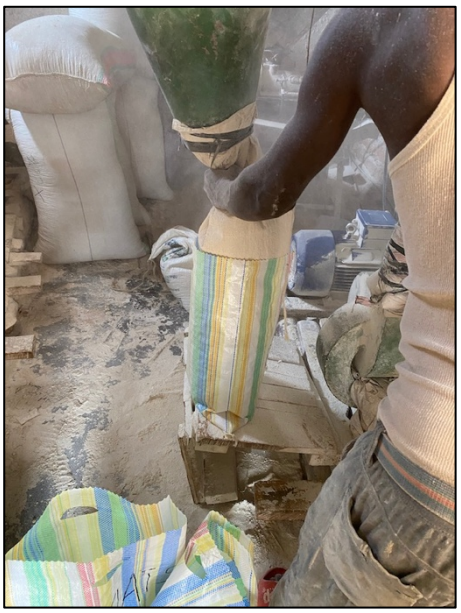


Regular Mill, screen type



Regular Mill, screen type

Regular Mill, screen type



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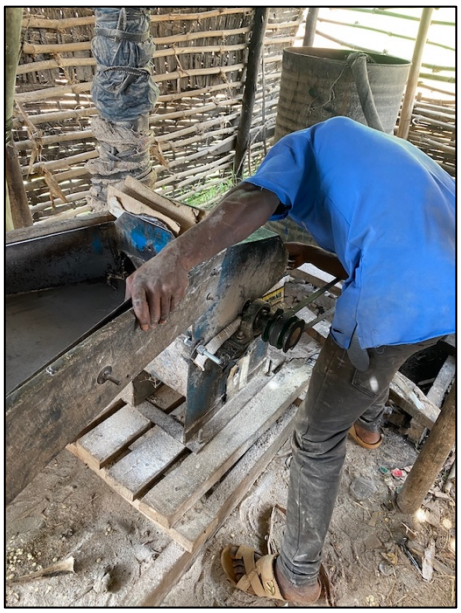
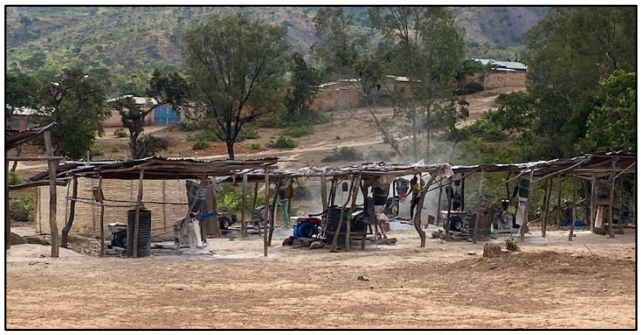
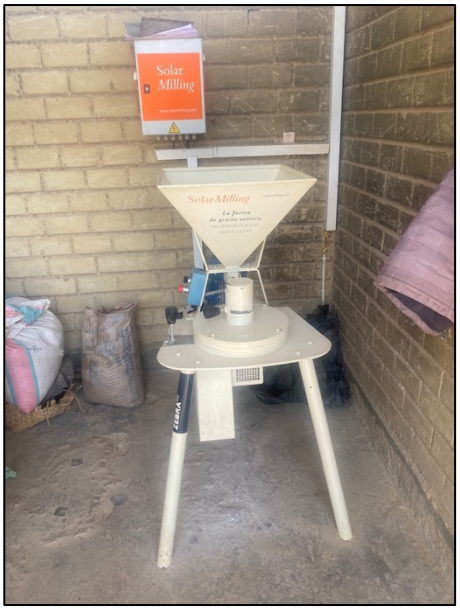


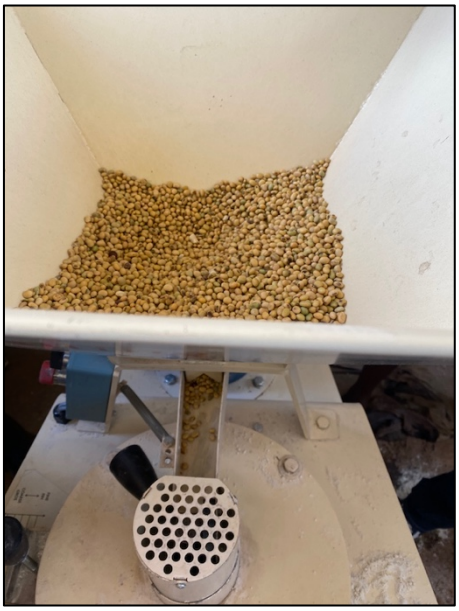
Regular Mill, screen type



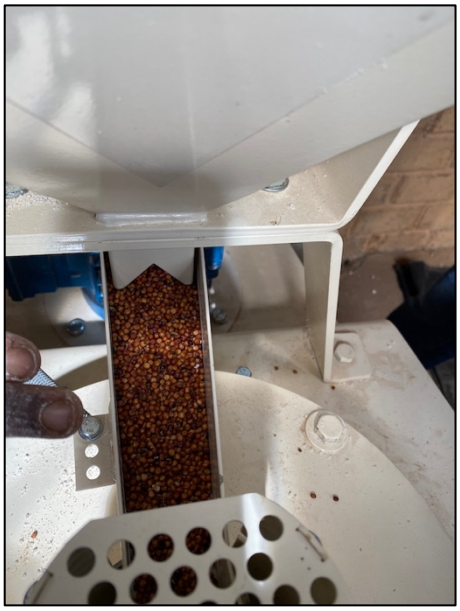
Regular Mill, screen type



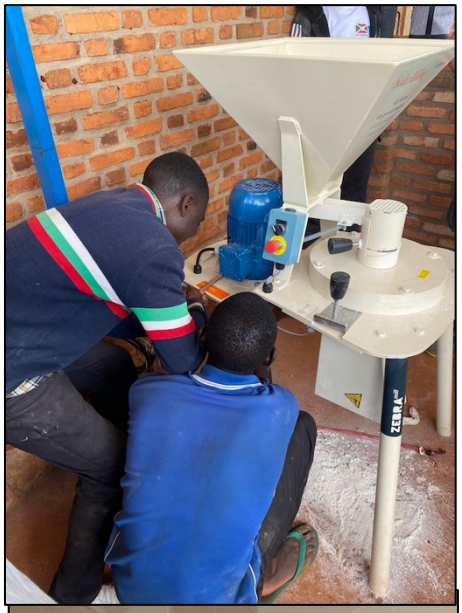
Zebra Solar Mill, screenless type



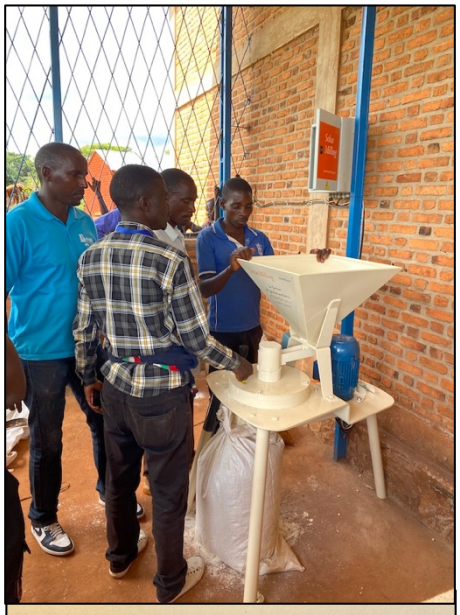
Zebra Solar Mill, soybeans grinding test



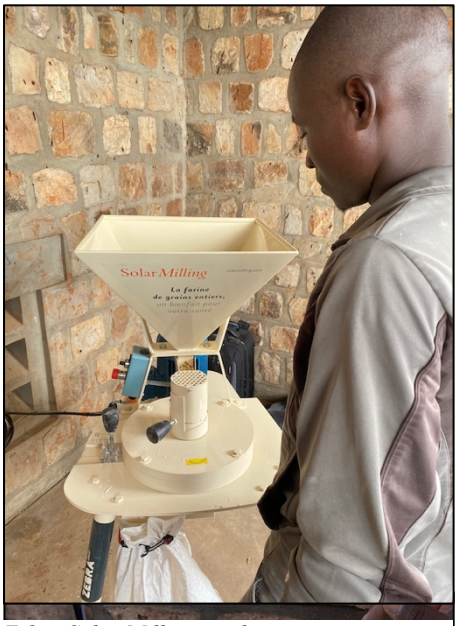
Zebra Solar Mill, sorghum grinding test



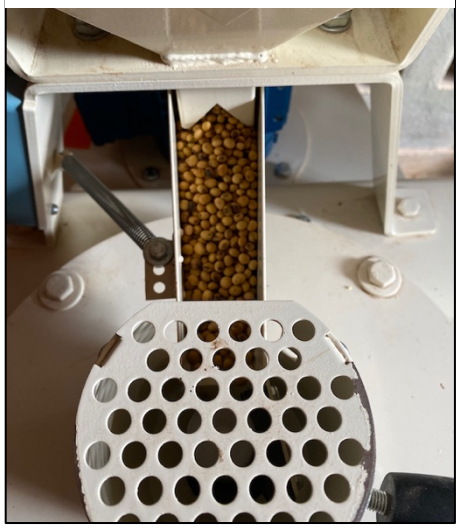
Zebra Solar Mill, screenless type



Zebra Solar Mill, screenless type



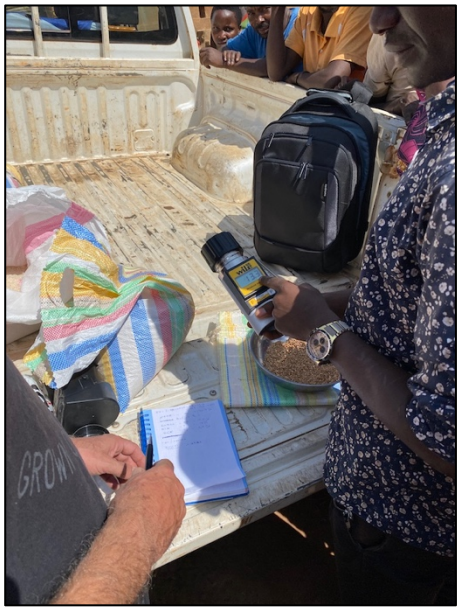
Zebra Solar Mill, screenless type



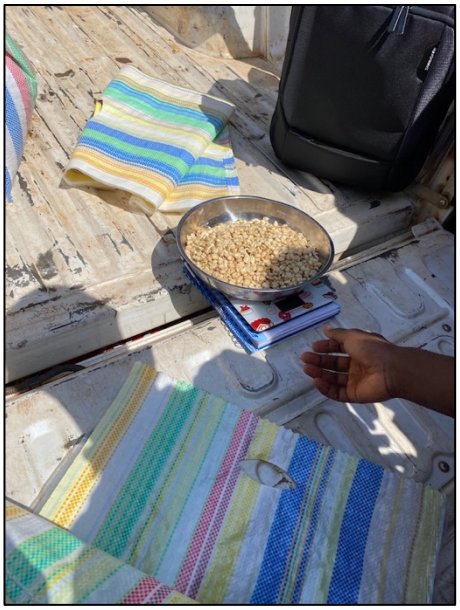
Zebra Solar Mill, screenless type

Zebra Solar Mill, soybeans grinding test

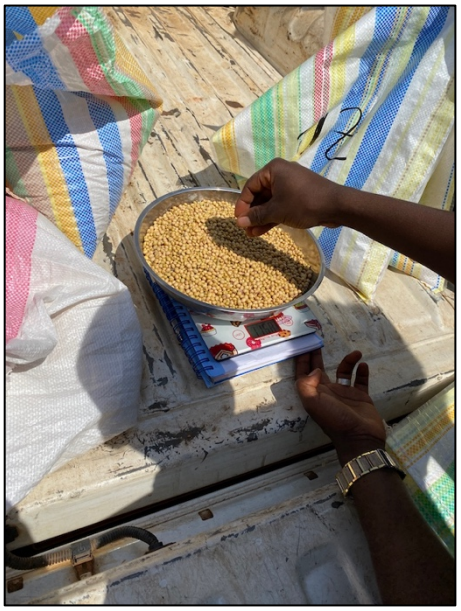
Zebra Solar Mill, maize grinding test



Moisture meter



Grain sample scale



Grain sample

Resultant flour from Zebra mill

PROJECT DEVELOPED AND FUNDED BY LVIA ITALY

Servizio di pace LVIA