DESIGN, FABRICATION AND PERFORMANCE EVALUATION OF A PORTABLE POTATO DIGGER

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- Philippine has an average potato production of 118,497 metric tons from 7,939 hectare
- 85 % are in Cordillera Administrative Region (CAR) particularly in Benguet and Mt. Province





• Benguet and Mt. Province has the ideal climate but confronted with problems inherent to topographical condition.

Characteristic	CAR	Mindanao	
Field Size	Relatively Small	Comparatively Larger	
Geography	Very Hilly	Relatively Flatter	
Accessibility	Majority Inaccessible	Majority accessible	
Mechanized Farming	Difficult	Doable	
Source: Wustman et. al. (2010)			



Production Areas in CAR



Production Areas in Mindanao

• Mechanization is difficult due topographical condition and inappropriateness of existing potato diggers and harvester design.



• Thus, harvesting still carried by hand and the most labor intensive operation at present



• Harvesting is tiresome, lack of labor force, limits the area and can't catch up the good price

Objectives:

- Design and fabricate a portable potato digger,
- Test the performance of the digger in terms of machine capacity, efficiency, tuber lift and tuber damage
- Perform financial analysis of the device

METHODOLOGY

- Background
- Design considerations
- Design and Fabrication
- Instrumentation
- Data gathering
- Statistical Analysis
- Financial Analysis



Work Flow of the Study

METHODOLOGY

Performance Parameters

1. Effective Field Capacity (Cef)
$$= \frac{A}{T_p + T_n}$$

2. Field Efficiency (Ef) $= \frac{C_{ef}}{C_T}$

3. Tuber Lift (%) =
$$\frac{m_1}{m_1 + m_2}$$
 x100

4. Tuber Damage (%) =
$$\frac{m_4}{m_4 + m_3}$$
 x100

METHODOLOGY

Performance Parameters

Effective Field Capacity (Cef)
Field Efficiency (Ef)
Tuber Lift (%)
Tuber Damage (%)

TREATMENT	FREQUENCY, Hz		FORWARD SPEED, kph	
(engine RPM)	Digger blade	Sieving web	no load	with load
2000	10.0	10.0	0.97	0.363
2200	10.3	10.3	1.05	0.538
2400	11.7	11.7	1.13	0.656

Description of the Device

- Light in weight, 87 kg
- easily detachable for transportation
- designed using locally available materials





Performance of the Device

DADAMETEDS	TREATMENTS		
	T ₁ (2000rpm)	T ₂ (2200rpm)	T ₃ (2400rpm)
Effective Field Capacity (m ² /hr)	159.00 ^c	320.00 ^b	400.00 ^a
Digging Efficiency (%)	52.58 ^b	71.43 ^a	69.45ª
Tuber Lift (%)	96.76 ^b	98.88^{a}	99.00ª
Tuber Damage (%)	4.13 ^a	2.66 ^b	3.28 ^{ab}
Fuel Consumption (L/hr)	0.75 ^c	0.92 ^b	1.15 ^a
Wheel Slip (%)	88.4 ^a	85.22 ^b	82.7°

Performance of the Device vs Manual Operation

CapacityTuber LiftTuber Damage



	PARAMETERS		
TREATMENT	Capacity (ha/hr)	Damage (%)	Tuber Lift (%)
Machine	0.0400 a	3.28a	99.00a
Manual	0.0046 ^b	2.77a	98.63a

Financial Analysis



CONCLUSION

- A portable potato digger suitable to the farm condition in the Cordillera region was fabricated.
- Best at 11.67Hz blade oscillation and forward speed of 0.6 kph



• Features of the Device:

- ✤ 400 m²/hr capacity
- 99 % tuber lift
- Php 29,365.00 Machine cost
- Breakeven of 1.31 ha
- 78,720.00/yr projected income

IMPACT



DIGGER MACHINE	PARAMETRS	MANUAL LABOR
400 m ² /hr	Capacity	46 m ² /hr
Php.3400/ha	Harvesting Labor Cost	Php.10,000/ha



- Reduces manual labor force
- More than 50% Reduction of harvesting cost
- Reduces drudgery of manual harvesting
- On time product market delivery
- Promotes extensive farming
- Increases income

"IMAGINATION IS MORE IMPORTANT THAN KNOWLEDGE. KNOWLEDGE IS LIMITTED . IMAGINATION ENCIRCLES THE WORLD"

Albert Einstein