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Economic Performance of Small Scale Private Irrigation Scheme: A Case Study of the Tin Mining Ponds of the Jos Plateau, Nigeria

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ABSTRACT Increasing the crop water productivity in smallholder farming is important since the productivity is often low but has the largest potential to be enhanced. In Nigeria, tomato and pepper forms a very important component of many households' diet. Their production is mainly a smallholder activity characterized with low productivity compared to the world average. In explaining the low productivities of the farmers, it is necessary to look into the profitability of their farm enterprise to show the close links existing between productivity and farm income. This study estimates the profitability of tomato and pepper production using the gross margin analysis to determine the farm income on smallholder farms of tin mining ponds of the Jos-Plateau. Empirical result indicates that tomato and pepper production are profitable. The average rate of return to a naira invested in tomato and pepper production were ₦0.87k and ₦1.49 respectively. To fully tap the potential of increase productivity and farm income, the study recommends that expanded access to improved technologies for tomato and pepper production should be extended to the farmers through extension services. Implications for policy are discussed.

INTRODUCTION

With increasing population, income growth and enhanced purchasing power of people, agriculture has been under pressure to produce more to meet food requirements (Tanwar et al. 2014). Increase food production could be achieved by putting more area under cultivation or by increasing the productivity through irrigation, cropping intensity and soil fertility enhancements (Tanwar et al. 2014). Water has been a crucial input for improving agricultural productivity and is essential for all human, animal and plant life as well as for most economic activities (Meinzen-Dick and Rosegrant 2001). Increasing demand and competitiveness for water use among traditional sectors of water users, namely agriculture, industry and urban supply has put water resources under pressure (Moreno-Perez and Roldan-Canas 2013). Farming households and nations have depended on rain-fed agriculture for improved food and livelihood security for many generations (Anderson et al. 2009). Irregularities in timing and distribution of rainfall, which may be further exasperated by projected changes in climate, often leave communities without access to water for the most basic daily needs, including farming activities (Bulcock and Schulze 2011). Water shortages causes land degradation in rain-fed agriculture (Suleimenov et al. 2011), and also decreases food productivity in arid and semi-arid regions of Africa (De Fraiture et al. 2010). Today's agriculture aimed at producing more food from less water particularly in arid and semi-arid regions (Shideed 2011). Increasing the crop water productivity in smallholder farming is important since the productivity is often low, but has the largest potential to be enhanced (Molden 2007). More efficient utilization of available water resources has the potential to contribute towards alleviation of water scarcity, and is essential for improved food security especially in rural areas where majority of the food insecure population depend on rain-fed agriculture for their livelihood (Liu et al. 2008).

In Nigeria, where the majority of the farmers are smallholders with 1-3 hectares, small private irrigation schemes (SPRI) are likely to bring high returns per hectare than government-led schemes (Takeshima et al. 2010). SPRI allows irrigation scheduled to be adjusted in accord with crop needs, providing the right amount of water at the right time to farmers (Dauda et al. 2009), and compensating for localized problems of erratic rainfall (Phillip et al. 2009). SPRI thus offers flexibility for Nigerian farmers, who are, generally, highly constrained in managing pro-

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duction schedules (Takeshima et al. 2010). It also usually leads to higher profitability of various crops (Yaro 2004) and benefit farmers (especially female farmers) by producing more food crops in the 'slack' period of rain fed-agriculture, it enables households to irrigate garden vegetables, water livestock and undertake microenterprise (Westby et al. 2005). Tomato and pepper forms a very important component of many households' diet in Nigeria, and their production is mainly a smallholder activity characterized with low productivity compared to the world average. Non-adoption of available hybrid/HYV seeds, incidence of pests and diseases, poor nutrient management and lack of irrigation technologies have been given as possible reasons (Goni et al. 2007).

Irrigation contributes to livelihood improvement through increased income, food security, employment and poverty reduction (Hussain and Hanjra 2004; Lipton 2007). According to Lipton et al. (2003), irrigated agriculture can reduce poverty, through increasing production and income, and reduction of food prices, that helps very poor households meet the basic needs and associated with improvements in household overall economic welfare; protecting against risks of crop loss due to erratic, unreliable or insufficient rainwater supplies; promoting greater use of yield enhancing farm inputs and creation of additional employment, which together enables people to move out of the poverty cycle. Also, irrigation contributes to agricultural production by increasing crop yields, and enabling farmers to increase cropping intensity and switch to high-value crops (Zhou et al. 2008). Therefore, irrigation can be an indispensable technological intervention to increase household income (Speelman et al. 2008). Access to irrigation provides farmers with a reliable water source at critical times in the crop's life cycle, removing the dependence and inherent uncertainty of rain-fed. The length of dry-season irrigation typically ranges from 2 months (Dauda et al. 2009) in southern Nigeria to 6 months in north-central Nigeria (Pasquini et al. 2004), implying significantly higher demand for irrigation in the north during dry season.

Water for irrigation can be acquired from different sources which include rivers, reservoirs, dams and ground water; it then can be transported to the field by farmers individually or in a group as an irrigation scheme. Some farmers in northern Nigeria have managed to develop a production system adapted to drier conditions (Hartenbach and Schoul 2005). In the Jos Plateau as a result of open cast tin mining activities that took place in the early 20th century to late 1990s, many mining ponds were created on the surface which acts as water reservoir, the abandoned mining ponds that get impounded with water throughout the year, have become one of the major sources of employment, food security, and income to the communities, through its irrigation potentials, source of water for livestock, fishing and other domestic activities, even though they were not deliberately constructed to serve these purposes. These areas have now become one of the leading producers of vegetables and tuber crops in Nigeria, such as tomatoes, cabbage, carrot, peppers, eggplant, cucumber, green pea, green beans, fresh corn, Irish potatoes, sweet potato and cocoyam (Alexander and Kidd 2000). The spread of private irrigation among farmers was in part driven by the improvement of terms of trade for agricultural commodities (Acharya 2004), and the growing market for vegetables possibly due to rapid urbanisation (Ogunjimi and Adekalu 2002).

The Mines Land Reclamation Unit (MLRU), have reported it was not feasible to reclaim soil affected by mining activity on the Jos Plateau for arable agriculture (Alexander 1996), farmers have however been 'informally' reclaiming mined land since the first commercial mines were established. This was initially carried out in water courses altered during mining, which allowed the expansion of traditional dry season *fadama* (Hausa: lowland area) farming methods that involved the utilisation of moisture reserves found in and along river channels and water courses. As the number of mining ponds and pressure on land began to increase, farmers expanded their output of highly marketable vegetables by using water lifting technologies to enable them establish standard irrigation practices. This expansion initially involved the use of the *shadouf* (a long slender pole with a container, usually made from animal skin, attached to its end) to raise water from streams and ponds, but as this is labour intensive, only small areas could be irrigated. Over the last 20 to 30 years the *shadouf* has been replaced by 'pump engines' (small petrol or diesel pumps), which have enabled a massive expansion in irrigated agriculture to take place (Phillips-Howard et al. 1990). The devel-

opment of irrigated dry-season farming on land disturbed by mining has been one of the more obvious reclamation strategies of the informal sector, which, in some locations shows an increase of 100% in the last 15 years (Alexander and Kidd 2000). The mine lands, especially the flooded mining paddocks are also used as water sources for the Rock Water Fish Farm and industry such as the Jos international Brewery and the plateau Bottling Company (Alexander 1989).

With the irrigation-based cultivation process, the northern Sudan Savannah has become the major vegetable producers in Nigeria. Among the wide range of vegetable grown, tomato and pepper are the most important both in scale of production and consumption. The tomato is grown by all dry season gardeners who regard it as a principal crop. It occupies more land than the other vegetables combined (Adepetu 2007). Furthermore, their production, handling, transportation, distribution and marketing have the capacity to contribute to household income and sustainability through employment for many of the population. This study examines the impacts of irrigation on farm incomes at the household level for farmers using the tin mining ponds of the Jos-Plateau.

MATERIAL AND METHODS

Study Area and Method of Data Collection

The study was conducted in Barkin Ladi local Government area of Plateau State Nigeria. The area is located in the central part of the country and lies between latitude 8°30' and 10°30' N and longitude 7°30 and 8°37' East with a land mass covering 53,585 square kilometers. The plateau is some 300–600m above the surrounding plains (Alexander and Kidd 2000). At this altitude, the monthly mean temperature recorded is about 20–24^{0}C. Rainfall on the plateau totals about 1400mm annually, which falls primarily over a period of 7-months, from April to October. Although, Jos Plateau can be described as having a tropical rainy climate with an average humidity of about 60% and heavy rains between June and August. It also has a temperate feeling with an average temperature of 22 °C and temperatures as low as 8°C to 10^{0}C recorded during the Harmattan season (winter) between December and February. The state has 17 local governments (councils); it shares common borders with Taraba, Kaduna, Nasarawa and Bauchi States. Plateau State has an estimated population of 3,178,712 people and form about 2.27% of the national population (NPC 2006). The State is located on a plateau landform (which is the reason for name of the state - Plateau). The land formation is categorized into two: upper plateau (rocky and a lot of hills) and lower plateau (sandy). Barikin-ladi Local Government is in the highland area of Plateau State; with an elevation of 900–1200m and has an estimated population of 175267. The population is highly heterogeneous with over forty ethno-linguistic groups.

A multistage stratified random sampling was used to select representative households for the study (Barnett 1991). In the first stage, a reconnaissance survey was conducted with the assistance of the extension staff from State Agricultural Development Project (ADP) to identify and list households in four communities purposively selected, since they are most prominent in using tin mining pools for the production of tomatoes and peppers within the Local Government Area. The selected communities are Rakum-Kassa, Gana-Ropp, Dorowa-Babuje and Barikin-Ladi). A focused group discussion was used to obtain background information on adaptations as well as adoption of tin mining ponds for vegetable production. This information was used to structure the questionnaire administered to respondents during the interview, which focused on their demographic, socio-economic and farming characteristics, institutions, resource use and the process of tin mining ponds technology adoption.

In the second stage, 153 respondent households (44 from Kassa, 16 from Barikin-ladi, 60 from Dorowa Babuje and 33 from Gana Ropp), were randomly selected to obtain a representative sample of the whole community. This consists of 89 tomato and 64 pepper farmers. Only farmers that cultivated tomato and pepper as mono-crops (sole-cropping) were interviewed.

Analytical Technique

The farm budgeting technique (gross margin and net farm income) was used for the analysis of the enterprise profitability. Gross Margin (GM) by definition is the difference between the gross farm income and total variable cost, while Net Farm Income (NFI) as a tool of partial bud-

geting was used because irrigation farming has fixed cost elements such as depreciation of motorized water pumps, hoes, cutlasses and hoses (Olukosi and Erhabor 1988). This evaluates the profitability of an individual farm enterprise and it is given as:

$$NFI = \sum_{i=1}^{n} PY_i - \sum_{j=1}^{m} P_i X_{xi} - \sum_{k=1}^{k} Fk \quad (1)$$

$$GM = \sum_{i=1}^{n} P_y Q_y - \sum_{j=1}^{m} P_i X_{xi} \quad (2)$$

where,

NFT = Net Farm Income (Naira/ha)

GM = Gross Margin (Naira/ha)

Q_y = Total output of crop (kg/ha)

P^y = Unit price of output (Naira/kg)

X_i^y = Quantity of the i^{th} input used (kg/ha)

P_{xi} = Price per unit of the i^{th} input (Naira/kg)

$Q_y P_y$ = Total revenue associated with the y^{th} output (Naira)

FK = Cost of fixed inputs (n)

$\Sigma X_i \; P_{xi}$ = Summation of all input prices to give Total Variable Cost *TVC*

$\Sigma P_y \; Q_y$ = Summation of output to give Gross Farm Income

The variable costs considered were cost of inputs such as land preparation, seeds and seedlings; cost of fertilizer; cost of labour for different farm operations; cost of agrochemicals and cost of petroleum products. Total revenue was estimated by multiplying the quantity of tomatoes/pepper produced by the market price at the time of harvest (N/kg). The fixed cost elements that were considered are depreciation on motorized water pump, hoses, and other farm implements. Straight-line depreciation method was used to determine the depreciated values. The straight-line depreciation method assumes that an asset loses value at constant rate. This method is therefore useful for assets that lose value constantly over their entire life. Depreciation by this method is the difference between the purchase price (P) and the salvage value (S) divided by the number of years of life of the asset (n).

$$D = \frac{P - S}{n} \quad (3)$$

RESULTS AND DISCUSSION

Socio-economic Characteristics of the Respondents

Households' demographic, socio-economic and farm characteristics play important role in determining the livelihood of rural farmers. The majority (91%) of the farmers who are male have an average age of 40 years. About 58% of the farmers are below this average, implying that majority of the vegetables growers are within the active and productive age bracket. In other words, the presence of these burrows pits for vegetable production in the study area provides employment and source of livelihood. Majority (54%) of the farmers belong to the Berom tribe, who are indigenous to the study area. About 22% of the farmers are Fulani, while 16% are Hausa. The high percentage of Beroms may be attributed to their accessibility to farmland through ethnic affinity and inheritance.

The level of education determines the level of opportunities available to improve livelihood strategies and managerial capability in production. The study revealed that about 80% of the farmers had one form of education or the other, while about 20% had no formal education. As practiced in many rural economies in Nigeria, farming is the major source of livelihood for households in the study area. About 75% of the respondents are either crop or livestock farmers. The average household size is 8 persons, with about 91% of the households having between 1-15 persons, and about 9% with more than 15 persons. Large family size is not uncommon with subsistence agriculture as it is required to meet the labour requirement on the farm.

Farm lands are assets of great importance to farmers, especially irrigable land due to their high productive capacities and scarcity. The ease of acquiring farm lands bear direct relationship with the hectares cultivated by the farmer vis-à-vis his output. About 49% of the respondents acquired their farms through inheritance and 20% purchased their farms, 20% through renting, 9% by borrowing, while 2% got their farms through leasehold. This indicate that majority of the farmers paid for the land they cultivated, thereby increasing their cost of production. As evident from the focus group discussion, all inheritable properties (including land) are often bequeathed to the male child. This could be a possible reason for the few female vegetable farmers in the area.

The total land area cultivated by the farmers was about 209 ha, with about 143 ha (68%) and 67 ha (32%) devoted to tomato and pepper production respectively. The average farm holding is 1.37ha. The average area under tomato farming is 1.60 ha and the average for pepper is 1ha (an indication of no statistical significant differ-

ence at p>0.05). The equipment used has been gradually modernized, about 95% of the respondents used petrol or diesel-fuel motorized pumps for their irrigation operations; about 2% of the farmers used the ancient *shadouf* (a long slender pole with a container, usually made from animal skin, attached to its end) system, while about 3% made use of water cans, buckets and calabashes to irrigate their fields. Farmers who belong to groups/associations are expected to have a strong link with institutions that serves farming communities, such as financial and extension institutions, research centres, inputs manufacturers and processors of farm products. Majority of the farmers do not belong to any groups/association and are therefore exposed to unfavourable prices of inputs and outputs, only about 24 % of the respondents belongs to cooperative societies. The distribution of the farmers based on their socio-economic characteristics is presented in Table 1.

Table 1: Distribution of farmers based on socio-economic characteristics (*n*=153)

Socio-economic characteristics	*(n)*	*Percentage (%)*
Gender of Farmer		
Male	139	91
Female	14	9
Age		
20-39	78	58
40-59	51	33
60-69	13	9
Education		
No formal education	31	20.3
Primary	55	36
Secondary/above 10yrs schooling	37	24
Quaranic/adult/vocational	30	19.7
Major Occupation		
Farming	115	75
Others	38	25
Family Size		
1-10	113	74
11-20	34	22
>20	6	4
Social Capital (Number of Groups/ Associations Belongs to)		
0	130	85
1-2	34	15
Tribe		
Berom	82	54
Hausa	33	22
Fulani	25	16
Others	13	8
Source of Capital		
Loan/credit	23	15
Personal savings	130	85
Land Ownership		
Purchase	31	20
Rent	31	20
Inheritance	75	49
Borrowing/lease hold	16	11
Total Land Cultivated		
Tomato	143ha	68
Pepper	67ha	32
Irrigation Method		
Motorised pumps	145	95
Shadouf	3	2
Water cans/buckets	5	3

Source: Data analysis, 2012

Costs and Return Analysis

This section gives the analysis of the resources employed by the farmers and the associated cost of production of producing tomato and pepper in the study area, the returns from the production process and profitability of the enterprises. Both fixed and variable resources such as land, labour, farm implements, water pumps and equipment, seeds, inorganic fertilizers, organic fertilizers, herbicides, insecticides, petrol and water are considered. The production factors were valued at the prevailing market price at during the 2012 production season.

Cost of Production

In estimating the costs of production, both variable and fixed costs were considered. The variable costs component included are costs of seeds, labour, *NPK*, *Urea*, *SSP*, cow dung, poultry litters, herbicides, insecticides, petrol and repairs, while the fixed costs considered are land rent, depreciation on water pumps, hoses and farm implements.

Variable Costs for Tomato and Pepper Production

i) Cost of Seeds/ Seedlings

The study showed that the respondents obtained their seeds and seedlings from various sources. About 64% bought their seeds/seedlings, 32% used seeds from their previous harvest and 4% obtained their seeds from government. The study also showed that about 78% of the respondents used improved seeds, while 22% used local seeds. An average of 161.10grams per ha and 209.43 grams per ha of tomato and pepper seeds respectively were used. The average market price for tomato and pepper seeds was ₦16.33/grams and ₦21.67/grams respectively, giving an average cost of seeds per hectare of ₦2, 655.43 and ₦4, 942.26 respectively for tomato and pepper production.

ii) Cost of Inorganic Fertilizers

Inorganic fertilizers were found to be widely used among the respondents. The commonly used ones are *NPK, Urea*, and *SSP*. On average, tomato farmers used per hectare 207kg of *NPK*, 98.50kg of *Urea* and 77.99kg of *SSP*, while pepper farmers used 418.79kg of *NPK*, 192.71kg of *Urea* and 131.97kg of *SSP* per hectare. This showed that pepper farmers used more of inorganic fertilizer than tomato farmers (this difference is statistically significant at $P<0.05$). The price of fertilizer was between ₦3, 000 and ₦5, 500 per 50kg bag. *NPK* is sold at ₦5, 500, *Urea* at ₦4, 000 and *SSP* at ₦3 000. The average cost of *NPK, SSP* and *Urea* used per hectare were ₦17, 138.84, ₦7, 880 and ₦4, 680 for tomato and ₦35, 179.20, ₦15, 416.92 and ₦7, 920 for pepper respectively. The unit (kilogram) cost of *NPK*, *Urea* and *SSP* are cost of ₦84, ₦80 and ₦60 respectively as shown in Table 2.

iii) Cost of Organic Fertilizers

The use of cow dung and poultry droppings (which has a high concentration of uric acid is often used in place of urea) is very common among the respondents in the study area. About 58% and 67% of the respondents made use of cow dung and poultry droppings respectively on their field to compliment the scarce and exorbitant inorganic fertilizer. On the average 34.86kg/ha and 278.19kg/ha of cow dung were used by the tomato and pepper farmers respectively, while 539.82kg/ha and 937.31kg/ha of poultry litters were used by tomato and pepper farmers respectively. The average cost of cow dung used by tomato and pepper farmers were ₦2, 231.17/ha and ₦2, 642.90/ha respectively, with an average cost of ₦6 477.85/ha and ₦1, 1238.75/ha spent on poultry litters for tomato and pepper production respectively.

iv) Cost of Agro-chemicals

An average of 2.61litres of herbicides and 3.04 litres of insecticides per hectare were used for the control of weeds and insects. The commonly used insecticides are: *Attack, Karate, Best*, and *VIP*, while the herbicides are: *Ronstar, Delsate, glyphosate and Delzine*. The average amount spent on insecticides by tomato and pepper farmers per hectare were ₦2, 052 and ₦3, 774 respectively, while the average spent on herbicides were ₦1, 615 and ₦3, 366 respectively. It is pertinent to note that pepper farmers used more of insecticides than the tomato farmers; this may be due to the long period required for pepper production (ranges from 4 months to 7 months). The tomato farmers on the average sprayed their field four times, while the pepper farmers sprayed theirs up to six times. Despite the use of herbicide, majority of the farmers performed weeding operation between two to three times.

v) Cost of Petrol

The results showed that more than 95% of the farmers used petrol engine water pumps for irrigating their vegetable farms. An average of 34.75 litres/ha and 46.43 litres/ha of petrol were used for tomato and pepper production respectively, translating into an average cost of ₦2 432.50/ha and ₦3 250.10/ha for tomato and pepper production respectively. This is an important cost component of irrigation farming on the mining ponds of the Jos Plateau.

vi) Cost of Labour

Labour is the predominant cost item of irrigation farming using mining ponds, accounting for about 58% and 42% of the total cost of producing tomato and pepper respectively. An average of 783.87 and 691.31 man-hours per hectare was employed, translating into an average labour cost of ₦86, 225.70 and ₦76, 045.20 per hectare for tomato and pepper production respectively.

vii) Total Variable Cost

The total variable cost of tomato and pepper production consists of cost of seeds, NPK fertilizer, Urea, super single phosphate (SSP), cow dung, poultry droppings, herbicides, insecticides, petroleum product and labour (i.e. the total of *i* to *vi* above) An average variable cost per ha of ₦133, 366 and ₦163, 775.80 were incurred on tomato and pepper production. This accounted for 89.47% and 89.49% of the average total cost for tomato and pepper production respectively.

viii) Total Fixed Cost

Fixed inputs remain unchanged irrespective of the level of production. Farmers are said to

have little control over the use of these inputs in the short-run. The total fixed cost consists of land rent, depreciation on motorized water pumps, hoses, and farm implements. The average fixed cost per hectare for tomato and pepper production were ₦15, 692.38 and ₦19, 260.61 respectively. This represents about 11% of the total cost of production for both tomato and pepper as shown in Table 2.

xiv) Total Cost of Production

This represents the summation of the total variable cost and the total fixed cost expenditure incurred in producing the crops (i.e. the total of *vii and viii* above). The analysis revealed that the average cost of producing a hectare of tomato and pepper were ₦149, 051.46 and ₦183, 191.78 respectively.

x) Tomato and Pepper Outputs

The quantities of tomato and pepper harvested from a given area under irrigation were valued at market price. The study revealed that an average yield of 3370.62kg /ha of tomato and 2497.95kg /ha of peppers were harvested.

Gross Farm Income and Profitability

Gross farm income was obtained by multiplying the total output of tomato and pepper by their respective prices. Average prices of ₦82.79k and ₦ 183.11k per kilogram were found for tomato and pepper from December to April respectively. This analysis revealed that the average gross return per hectare was ₦279, 063.35 and ₦457, 407.40k for tomato and pepper respectively.

Net Farm Income

This is the difference between the total value of output and the total cost of production. An average net farm income of ₦129, 994.34 and ₦274, 363.21 per hectare accrued to tomato and pepper farmers respectively. This difference is statistically significant at ($P<0.05$) and it showed that pepper production is more profitable than tomato (see Table 2). The average rate of return to a naira invested in tomato and pepper production were ₦0.87k and ₦1.49 respectively.

Table 2: Average production cost, inputs usage and returns per hectare of tomato and pepper production in tin mining irrigation ponds

Variables	*Tomato production*			*Pepper production*		
	Unit/ha	*Unit price (₦)*	*Values/ha (₦)*	*Unit/ha*	*Unit price (₦)*	*Values/ ha (₦)*
1. Yield/ha (kg)	3 330.62	82.79	279 053.63	2 497.95	183.11	457 399.62
2. Variable Cost:						
Seed (gm/ha)	162.58	16.33	2 654.93	228.10	21.67	4 942.93
NPK (kg/ha)	204	84	17 136.84	418.79	84	35 179.20
Urea (kg/ha)	98.5	80	7 880	192.71	80	15 416.80
SSP (kg/ha)	77.99	60	4 680	131.97	60	7 920
Dung (kg/ha)	234.86	9.5	2 231.17	278.19	9.5	2 642.90
Poultry litters (kg/ha)	539.82	12	6 477.84	936.56	12	11 238.72
Herbicides (*l*/ha)	1.89	900	1 615	3.75	900	3 366
Insecticides (*l*/ha)	2.28	850	2 052	4.44	850	3 774
Petrol (*l*/ha)	34.75	70	2 432.50	46.43	70	3 250.10
Labour (man- hr/ha)	783.87	110	86 225.70	691.31	110	76 045.20
3. Total Variable Cost (TVC)			133,366.00			163 775.80
4. Fixed Cost:						
Land rent			11 250			11 250
Depreciation			4 442.38			8 010.61
5. Total Fixed Cost (TFC)			15 692.38			19 260.61
6. Total Cost (TVC + TFC)			149 058.38			183 036.41
7. Gross Margin (1-3)			145 687.63			293 623.82
8. Net Farm Income (1- 6)			129 994.34			274 363.21
9. Return to Naira Invested			0.87			1.49

Source: Data analysis, 2012

CONCLUSION

This study estimate the profitability of tomato and pepper production using the gross margin analysis to determine the farm income on smallholder farms of tin mining ponds of the Jos-Plateau. From the findings of this study, it can be concluded that the farmers using the tin mining ponds for irrigation and production of tomatoes and pepper in the study area are making profits, and this enterprise can be said to be a profitable business venture.

POLICY RECOMMENDATIONS

Although, the farmers are faced with some production constraints, to fully tap the potential of increase productivity and income, this study proffers the following recommendations.

i. There is need to increase farmer's knowledge and perception of the benefit of private irrigation schemes through better access to technical information, extension and training on improved technologies on tomato and pepper production in terms of seed varieties, seed rates, spacing and plant arrangement, and date of planting and fertilizer use.
ii. Labour was the most predominant cost item for the production of tomato and pepper; there is therefore need for research to develop low cost technologies that will reduce the level of labour input for various farm operations.
iii. Government and private sectors needs to make credit facilities available to these small scale private irrigation scheme farmers in order for them to expand their scale of operation and be able to purchase the labour saving technologies that are made available through research.
iv. Furthermore, government and private sectors could enhance technology adoption appropriately with a better understanding of the nature and objectives of the existingsocial groups/networks in the tin mining ponds of the Jos-Plateau and use them for project designs and delivery.

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