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Assessment of Oyster Mushroom Production and Profitability in Harare Urban and Periurban Areas (RUWA), Zimbabwe

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Abstract

The study is an evaluation of the profitability of oyster mushroom production by small scale producers in urban and peri-urban settings with particular attention on trends in production and revenue during the period of 2014–2017. The Net Present Value (NPV), Discount rate and Benefit Cost Ratio (BCR) and Internal Rate of Return (IRR) were used to evaluate profitability. The average values of NPV, BCR and IRR for the year 2014–2017 were 13036.46, 15.75 and 141.42%, respectively. These values show that mushroom production has been very profitable during the period. Furthermore, production decreased between 2014 and 2015 before rising exponentially from 2015 to 2017. Major challenges in the production of mushrooms from the study included lack of financial support, marketing problems, lack of space for production, training, quality of spawns and substrates, temperature control, mushroom diseases, people's negative attitude and water shortages. It is therefore recommended that the Government and Non-Governmental Organisations (NGOs) should play a leading role in funding production. This could be done through contract farming, formation of mushroom growers association and provision of post services to producers.

Keywords: Oyster mushroom, profitability, biotechnology, lignocellulosic, fixed costs, variable cost

Introduction

Mushrooms are macro fungi with distinct fruiting bodies which can be hypogenous or epigeous, large enough to be seen by naked eyes and big enough to be picked by hands (Gebretsadkan 2015). The fruiting bodies are fleshy and spore-bearing. Edible mushrooms belong to the Fungi Kingdom, Division Basidiomycota, Class Basidiomycetes and Order Agaricales (Asemota et al. 2015). Mushrooms are found in three varieties, namely; the edible mushrooms, which can be used as food; the non- edible mushrooms, which can be used for medicinal purposes and the poisonous type mushrooms, which kill when consumed (Frempong 2000, RUAF Foundation2004). The button mushroom, oyster and shiitake are the three top types of mushrooms that make up 70% of the world production (Gebretsadkan 2015). The oyster mushroom is one of the *Pleurotus* species which is easy to grow at low cost (Rosmiza 2016, SIRDC 2017).

Mushrooms grow naturally in the wild and are the most popularly documented edible forest products (Gebretsadkan 2015). They have been consumed since ancient times for their nutritional and medicinal properties. Edible mushrooms are traditionally collected from the forests but now some are cultivated

(Zhang et al. 2014). Wild mushrooms are seasonal, so cultivation guaranties a constant supply to the market all year round. Mushrooms have multiple benefits that include high nutritional value, are used as food supplements and are grown throughout the year using cheap materials thereby improving food security. Mushrooms have important medicinal values which improve health (SIRDC 2017). They remediate and also clean the environment, create employment, save land and bring extra earnings to the urban farmers (Asemota et al. 2015). The mushroom spent substrates are recycled and can be used as animal feeds, soil conditioners, fertilizer, and used to produce other mushroom species (FAO 2007). The main aim of the study was to assess oyster mushroom production and profitability in Harare urban and peri urban zones, Ruwa as a case study. Most researches done on mushroom production in Zimbabwe were concentrating on mushroom production and its contribution as a food source side lining profitability, a gap which was covered by this study.

Mushroom productions make use of lignocellulosic materials which are obtained from agricultural, forestry or industrial wastes which include rice, sawdust, any grain crop residue (such as millet, rye, maize and wheat), logs, bagasse, chaff, water lily and cotton straw (Marshall and Nair 2009, Mamiro and Mamiro 2011, Asemota et al. 2015 and Zhang et al. 2014). Zimbabwe‘s economy is based on agriculture, so the lignocellulosic materials are found in abundance. Oyster mushroom cultivation is done in five stages, namely; substrate preparations, spawning, spawn–run, fruiting and harvesting (SIRDC 2017).

Mushroom production is labour intensive, so it creates employment to unemployed populace. Studies in Hai District of North Eastern Tanzania revealed that the youth, women and the elderly provided labour needed for mushroom production (Marshall and Nair 2009). Mushrooms are produced for family consumption and for sale, creating additional income to the family. Trading in mushroom is of economic benefit since it is a source of cash to the society as noted by Stankorb (2012). In addition, mushroom production cycle is short, giving a quick profit to the farmer (Celik and Perker 2009). Mushroom production makes use of lignocellulosic materials which are rich in cellulose, hemicelluloses and lignin which support mushroom growth. The lignocellulosic materials are agricultural, forestry or industrial wastes which include rice husks, sawdust, any grain crop (millet, rye, maize and wheat), logs, corn cobs, bagasse, chaff, water lily and cotton straw (Marshall and Nair (2009), Mamiro and Mamiro (2011), Asemota et al. 2015 and Zhang et al. 2014).

Mushroom production has increased globally by 10 times in the past four decades (Zhang et al. 2014). A gradual increase in world mushroom production had been observed for the period of 2000-2007. In 2000, mushroom production was 26 million tons and it rose to 33.4 million tons in 2007 (Celik and Pekers 2009, Gebresadkan 2015). The increase in mushroom output has been attributed to improvement in mushroom biotechnology, expansion of market demand, reduced life cycle of mushrooms, high tradability of mushrooms and low capital investment (Bradley 2013). The increase in mushroom demand and its tradability had necessitated the outgrowth of mushroom business enterprises. Viable enterprises make profits which are ploughed back to business for growth.

The profitability of a project can be analysed using the financial evaluation methods, which include Net Present Value (NPV), Discount rate and Benefit Cost Ratio (BCR). Frempong (2000) revealed that, Ghana had a national mushroom development project whose profitability was calculated in 1995 using both social and financial analysis. In that study, the evaluation results using a financial benefit analysis obtained a Net Present Value of 10.6 billion using a discount rate of 35% and Benefit Cost Ratio of 2.5. Fabozzi and Peterson (2003) indicated that, positive results using NPV, BCR and IRR is an indication of a highly

profitable project. The project was found to be of high financial benefit to the nation, hence it was worth undertaking. The major objective of a business is to make a profit hence financial evaluation is necessary to find out its potential profitability before undertaking it.

The objectives of this paper were to find out how mushrooms are produced in Harare, determine the level of mushroom production and describe the trends from 2014 to 2017, calculate the profitability of mushroom production, find out if operational costs can be used to determine yields, and identify challenges faced by the oyster mushroom producers.

Materials and Methods

The data were acquired from primary sources through visits to areas of production and some secondary sources such as articles, journals and reports from SIRDC (Scientific and Industrial Research and Development Centre). Both qualitative and quantitative methods were used for data collection. The qualitative approach instruments used were interview guide and personal observations. The quantitative approach instrument used was a questionnaire with both open ended and closed items and data obtained was analysed using linear regression analysis using Mini Tab Version 2019. The parameters used to analyse the profitability of the mushroom projects include the Net Present Value (NPV), Benefit-Cost and the Internal Rate of Return (IRR). Linear regression using a Minitab was used to find out if the amount of operational costs can be used to determine yield obtained or the relationship between operational costs and yield.

The target population was 50 mushroom farmers who are residing in Harare urban and peri urban areas. Both snowballing and purposive sampling were used to select and find the appropriate respondents (Berg 2001). Snowballing sampling involves one selected member suggesting other people who have the same characteristic as required by the researcher (Morgan 2008). In this research, SIRDC provided contact details for mushroom farmers they had trained and those who come to the institute for other mushroom consultation services such as purchasing of spawn, advisory and technical support. The main researcher was attached for three months (August to October, 2017) to the Microbiology Unit (MBU) of the SIRDC. During the period of attachment, the researcher managed to get data from mushroom farmers who came for different services at SIRDC and also managed to visit and interviewed other mushroom farmers previously trained at SIRDC or elsewhere. Snowballing method was used because it is commended as a low cost method of collecting data by Voicu and Babonea (2011).

For data analyses, the financial analysis methods were used to find the profitability of the project and the linear regression analysis was used for hypothesis testing using mini tabbing in order to meet set objectives. In order to meet the trends in the level of production by the farmers, each farmer's annual production figures were recorded starting from 2014 to 2017. The sum of each farmer's annual output gave the annual regional production.

Results and Discussion

Characteristics of the respondents

The respondents included (43%) males and (57%) females. This shows that the mushroom production study was dominated by females. Gender distribution among the respondents showed that, the mushroom production study was dominated by females. These results concur with the findings of Marshall and Nair (2009) and Gebretsadkan (2015) who reported that mushroom production is mostly practiced by females. Therefore, it is safe to say that females are more into mushroom production practices than their male counterparts.

On age distribution, the majority (43.3%) of the respondents were of the 30–40 age group, followed by 30–40 (23.3%) and 40–50 (23.3%) age groups. About 16.7% were above 50 years of age. The oldest respondent was 72 years. More than half of the mushroom

producers were youths of the age group 20–40 representing 69.99%. The least represented group was that of the teenagers with about 3.3%. Some of the teenagers said that they had completed ordinary level secondary school ('O' level) the previous years and had nothing to do, so they had to venture into mushroom production. On age distribution of the respondents, the results showed that, mushroom production is practised by people of different age groups with the youth dominating. Similar results were obtained in Addis Ababa by Gebretsadkan (2015) who found out that about 95% of the respondents were youths within the age of 25–44. The results also concur with the findings of Kumar et al. (2013) who also found out that mushroom production is done by people of all age groups irrespective of being challenged physically.

The education level of the respondents ranged from standard 3 to master's degree level (Figure 1). The education level of the respondents showed that 10% had the lowest level of education while the majority (43.3%) had 'ordinary' level. About 66.3% of the respondents had secondary level of education (both ordinary and advanced levels), 32.4% had tertiary education and 6.7% had master's degree level. All the participants were literate, able to read and write. Those with standard 3 education reported that they have been to school in the 1970s when education was in 'standards', and most of them were in their late 60s in age and all had retired from formal work. The respondents had a good level of education ranging from standard three to master's degree. Literacy is of great importance to mushroom production for it enables farmers to read and follow instructions. Financial literacy enables the farmers to perform basic skills such as book keeping, counting or numeracy skills. Some of the useful qualities of an educated farmer are being able to pay attention to the details and ability to carry out the income generating tasks (Marshall and Nair 2009). Education makes farming easier. Some highly educated people are able to innovate and come up with new technologies which can bring about change in the production of mushrooms and its sustainability. Gebretsadkan (2015) had the opinion that educated people allows the mushroom production to expand with increasing urbanisation. Educated people influence policy and regulations, hence influence the formation of policies which promote and protect their investments. All respondents were literate and included high level and low level of educated people. These findings contrast with the findings of Frempong (2000), who noted that, in Ghana mushroom production was practiced by uneducated people derailing mushroom production. Highly educated respondents are of significance to the group in terms of sharing new skills and introduction of modern biotechnology techniques to other respondents through group or family trainings. Unlike other developing countries, mushroom production in Zimbabwe is geared for success because it is practised by literate people who are able to work as a team.

On marital status, the results showed that majority of the participants were married and constituted about 53.3% of the sample. Single respondents (23%) were mostly young men staying with their parents but having their own growing rooms. Widows and divorced (23%) were mostly females staying and practising mushroom production with their families. The results showed that mushroom production is practised by all people irrespective of their marital status. In the interviews carried out, all the respondents lived with their families and most of them were extended families.

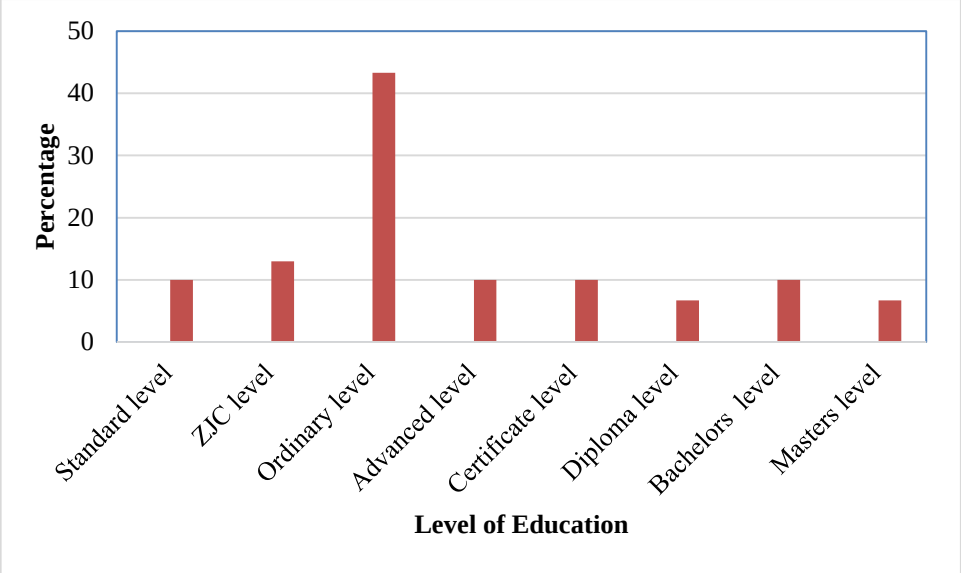

Figure 1: Levels of education of mushroom producers (Source: survey data).

Most of the mushroom producers (73.3%) were unemployed as compared to the formally employed (26.7%) and both depended on the family team work for the success of the mushroom production. These observations concur with the studies carried in the Republic of Kenya, which revealed that family workforce provide free labour which reduces costs and increases revenue (Marshall and Nair 2009). Related research in China showed that, mushroom industry consisted of numerous small scale family driven mushroom projects throughout the country, making use of family labour (Zhang et al. 2014). Mushroom production need close management as indicated by some farmers and some are taking it as a substitute for formal employment. Related findings came from Gebretsadkan (2015) who reported that, mushroom production is more important than some formal jobs. Therefore, it is possible to say that most of the small scale mushroom farmers were unemployed and regarded mushroom farming as a form of employment.

Substrates used and preparation

The farmers used a variety of substrates, including soya beans husks, maize stalks, cotton seeds (hulls), banana leaves and wheat straw. Figure 2 shows that majority (53.3%) of the farmers preferred using maize stalk, followed by soya beans (43.7%) and the least preferred substrates included sawdust (3%). It was also observed that 90% of the mushroom producers who used maize stalks were from peri urban areas, with larger pieces of land for growing maize for consumption. It was also noted that urban mushroom producers preferred soya beans straw and wheat they got from nearby farms. This was observed from mushroom producers who lived in low density areas such as Mount Pleasant and plots around Wesley suburb. Cotton hulls were used by a few because of its unavailability and high cost of transport involved in its transportation. Though sawdust was reported to be in abundancy, it produced very low yields, so it was least preferred. Farmers from high density areas such as Budiriro, Kuwadzana and Cold Comfort used banana leaves and cotton hulls they got from their neighbours. Cotton hulls were obtained from cotton ginnery in Norton

and some from Glen View industrial area. Other mushroom farmers obtained maize stalks from previous harvests from their small stands, small pieces of land they cultivated along roads and on empty spaces. The responses on substrates preferences and use showed that farmers used the resources for substrates which were commonly available in their areas. The study's results showed that the available and commonly used substrates include maize stalks, soya bean, wheat straw, banana leaves and are in line with other several studies that have revealed the use of such substrates (Mamiro and Mamiro 2011, Zhang et al. 2014, Asemota et al. 2015). To reduce costs of buying substrates, there is need to expose the mushroom farmers to alternative forms of substrates such as grass, a substrate in abundant in the country but being not used for production.

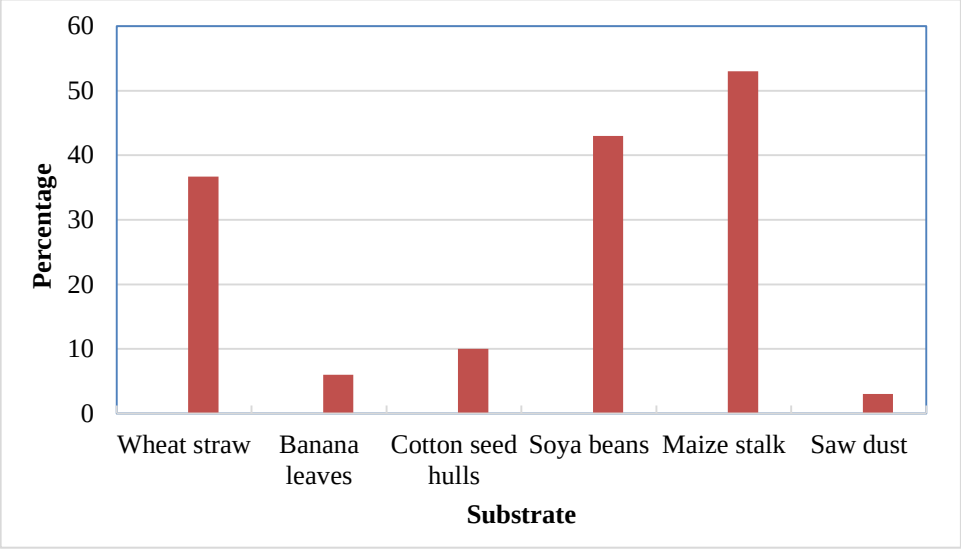

Figure 2: Substrate preferences by farmers in percentages (Source: survey data).

The substrates need to be treated before use to get rid of pests. The results showed the use of steaming (6.7%) and boiling substrates (80%) using electricity and use of chemicals such as hydrated lime (13.3%) as alternative ways of treating substrates in Harare and they concur with the recommended methods (Oei and Nieuwenhuijzen 2005, FAO, 2007, SIRDC 2017). The majority (80%) preferred boiling the substrates in drums for 2 hours but complained that they consumed a lot of time and wood. The mushroom producers complained of high costs of wood and shortage of chemicals such as lime for mushroom substrate treatment.

Registration

None of the farmers had registered their mushroom business, though 30% of them showed intentions to register. Most of them were afraid that the Zimbabwe Revenue Authority (ZIMRA) would follow up and tax them. Some thought that it was unnecessary to do so since they do not register their vegetable gardens. The mushroom farmers appear to lack advice on establishing mushroom enterprises.

Record keeping

About 87% of the producers had a challenge in keeping records. Only 13% of farmers kept records of the production costs and revenues created. For the 13% of respondents who kept records, most records

kept were for the spawn, pesticides, debtors and the quantity owed but no yields and sales; hence, very few were used to calculate productivity. It seemed as the farmers received insufficient training because they lacked basic financial literacy (Marshall and Nair 2009). Business and entrepreneurial skills are essential in running small projects. These skills include planning, administration, coordination, packaging, negotiation skills and marketing (Marshall and Nair 2009).The respondents seemed to lack simple book keeping techniques of recording revenue and expenses of their production. There is need to put such basic entrepreneurial skills as part of the training on mushroom course outline.

Experiences

About sixty percent (60%) of the farmers had less than 5 years' experience of mushroom production and a quarter of them were beginners. These results concur with Gebretsadkan (2015) who found out that about 85.5% of mushroom producers in Ethiopia had less than 5 years in mushroom production. Hence, mushroom production in Harare urban areas appear to be at its infancy since most of the production is less than 5 years.

Mushroom growing structures

The mushroom farmers used various types of mushroom growing structures. Very few respondents used rooms within the house while the rest used structures outside the main house. The observed mushroom growing structures included wooden cabins roofed with iron sheets but covered with grass on top as an insulator, cottages and round kitchens built of bricks roofed with asbestos or thatched with grass. Some roofs were covered with cardboards wrapped in aluminium foil to reflect away sun light and reduce temperature. Each mushroom producer farmer had at least two mushroom growing structures which were used as darkrooms or as fruiting rooms. The maximum number observed was 5 and were used rotationally. In the peri urban areas, the growing rooms were mainly some distance away in front or on the sides of the home stead for security reasons while in the urban areas the structures were all at the back yard. The rooms were modified inside with wooden poles to form structures for hanging mushroom bags. The materials used for marking mushroom growing structures by participants, matched with other researchers' findings which included bricks, wood and grass (Chiroro 2004 and SIRDC 2017).

A recommended mushroom structure has the following features: should be measured 8 × 6 m, brick motor structure, cement floor, gable thatched roof, jute bags ceiling, and screened windows (Mabveni 2009). The observed structures of this study fell short of the required standards except of a few (10%) which were above 50 m^2. The fact that most of the structures used by mushroom farmers in this study were 30 m^2 and below concur with the reports of Zhang et al. (2014) and Rosmiza et al. (2016) that mushroom production does not require a lot of space. In Malaysia, it was observed that meeting expected standards on growing structures and increasing the size of land under production, impacted positively on mushroom production by increasing yields (Tanni et al. 2012). There is great need for the farmers to work on improving the housing structures to meet the expected standards in order to increase the production values.

Size of production

Majority (33.3%) of the mushroom structures were 30 m^2, followed by (26.7%) those with 25 m^2. Very few (10%) farmers had structures above 50 m^2. Two structures per farmer were observed in the peri urban areas. These included the dark room usually a thatched brick walled kitchen and a temporary grass thatched structure with hammered or hardened floors, built for mushroom fruiting. Mushroom producers in the low density areas had larger and more mushroom structures than in the high density areas. Some were noted to have five cabins made of wood in low density areas. Cerlik and Perker (2009) carried out a study on mushroom productivity in Turkey and

found out that increase in land availability increased mushroom production and revenue. There is need for the Ministry of Agriculture to look into the plight of the mushroom producers and allocate them bigger pieces of land for mushroom and substrate production.

Growing cycles and productivity

Within the 4 year period, the respondents had different growing cycles (Figure 3). About 23.3% grew once, another 23.3% grew twice, and 20% grew three times a year, and 33.33% grew 4 times a year. The mushroom producers indicated that the cycles varied with substrates, some substrates such as soya beans took two months while others such as cotton hulls took three to six months harvesting. The respondents also said that it was possible to produce an average yield of 6 kg per bag size 1 metre by 0.7 metre of 10 kg wet substrate when the bags were packed fully.

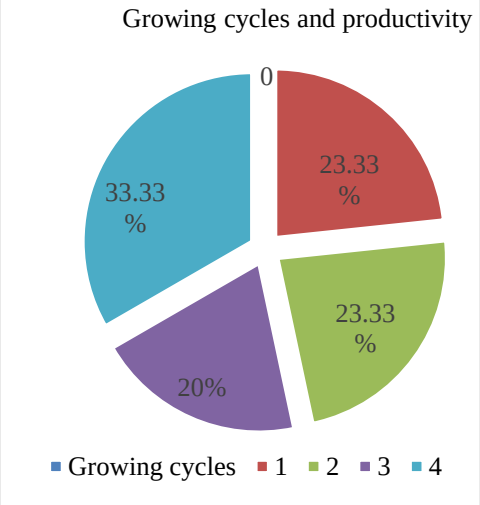

Figure 3: Growing cycles and proportion of mushroom farmers (Source: survey data).

Mushroom production is considered as a short return business by many researchers and can be repeated several times within one year. The average cycle for the mushroom production lasted for at most 4 months depending on the substrates used. From the study, mushroom was grown on average 3 times a year. It seemed the projects under study have the least production cycles per year as compared to other studies (Celik and Perker 2009, Gebretsadkan 2015). A study in Ethiopia on mushroom productivity showed that mushrooms can be produced 7-8 times a year at an average yield of 5-7 kg per bag (Gebretsadkan, 2015). In addition, a study in Turkey showed that mushroom production cycle lasts between 60 to75 days and production was done 5 times a year (Celik and Perker 2009).

Mushroom markets

All the mushroom producers sold their mushrooms in the local market. Majority (86.7%) of the respondents made bulky sales to local supermarkets, elite restaurants, food outlets and hotels. Fewer farmers (13.3%) sold to their neighbours, schools and churches. All farmers sell fresh mushrooms, however, dried mushroom is sold on request. Only 3.3% of the mushroom producers said that, they produced mainly for family consumption and only sold when there was excess.

The selling prices also varied with the markets. Farmers were selling to individual customers a 200 g mushroom punnet at $1 and to super markets and other bulk buyers at an average of $0.70. The calculated average cost of a one kilogram pack of mushroom was $3.5 to $5. The market is one of the required inputs for a mushroom producer. Marshall and Nair (2009) stated that, a farmer has to find a market first before producing mushrooms because of the perishability nature of mushrooms. When a farmer finds a market, the selling price can be negotiated before production; otherwise the farmer dances to the tune of the buyer at the market. Mushroom production appears to be mainly for commercial purposes than family consumption in this study.

The reports on price changes and some problems faced by mushroom farmers including lack of knowledge of marketing strategies were cited by Chiroro (2004) as constraints to mushroom production and profitability in Zimbabwe. Lack of marketing

strategies reduces revenue and income from the sales. The respondents also indicated lack of price control at the market resulting in low sales and uncontrolled rise in inputs prices. In other countries such as Nepal, dealers at the market fix prices according to demand and availability for the mushrooms (Poudel and Bajracharya 2011). It appears that mushroom producers do not determine prices at the market but the demand of mushrooms determines the prices.

Mushroom production training, diffusion and support

About 70% of the respondents indicated that they were trained. Most farmers (53%) got training from government institutions such as SIRDC and while 47% got training from peer farmers. Observations were that trained farmers team up and invited people for mushroom training using social media. Those who are interested turn up for training at one of the trained member's house. The informal training sessions usually lasts for 3 hours. During the training sessions the would- be farmers are taught how to treat substrates, pack substrates and spawn and hanging the spawn bag in the mushroom structure practically. Besides group training, there is family training whereby family members learn by doing the procedures with trained member at home.

The support from governmental institutions such as SIRDC included technical support, market information and advisory. These findings on government support with such services are in contrast to studies which found out that most mushroom production is side-lined by the Agricultural Ministries in developing countries (Marshall and Nair 2009). The observed results concur with Zhang et al. (2014) who observed that the Chinese government support mushroom growers in different ways. There is need for the Ministry of Agriculture, Zimbabwe to look into the financial support problems and find ways to improve the entrepreneurial skills of the small scale mushroom producers if they are to take their production to greater heights. Respondents also reported that they received training at higher costs from Governmental institutes as compared to informal training by other trained producers or other private organisations. The support they got from family members is in the form of labour.

Business and entrepreneurial skills are essential in running small projects. These skills include planning, administration, coordination, packaging, negotiation skills and marketing (Marshall and Nair 2009). The respondents seemed to lack simple book keeping techniques of recording revenue and expenses of their production. There is need to put such basic entrepreneurial skills as part of the training on mushroom course outline.

The study findings showed that high costs of training side-line the poor populace from receiving adequate skills and this concurs with the observations by Gebretsadkan (2015) that the small scale farmers are poor, get small profits and cannot afford high costs. Therefore, high costs of training favour the elite side-lining the poor populace from getting required skills for mushroom production as noted by Crush et al. (2010).

Challenges faced by mushroom farmers

The farmers were asked to give challenges they faced during mushroom production and also to suggest possible solutions. The farmers indicated that they faced the following problems: lack of financial support, market challenges such as fluctuations of buying and selling prices, lack of production space, attitude by customers to mushrooms, training, problems of mushroom pests and insects, mushroom diseases and temperature control and perishability of the mushrooms. The proportions of farmers who experienced the problems were as indicated in Figure 4.

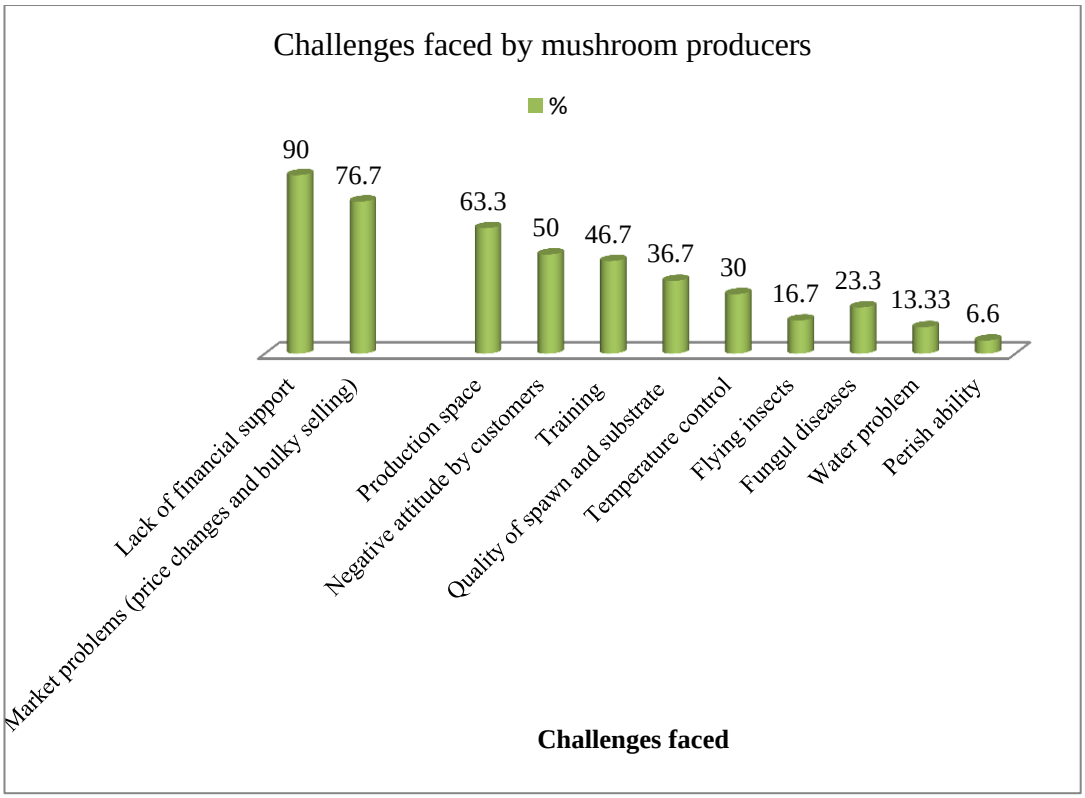

Figure 4: Challenges faced by mushroom producers (Source: survey data).

Lack of financial support

Every investment needs capital injection for capital investments, operation and maintenance costs. Around 90% of the respondents indicated that, they needed financial support to upgrade their facilities, increase production and invest in new technology which they lacked. They reported that they are denied loans by banks because they do not have collateral required by the financial institutions. Hence, the respondents have difficulties in expanding their production facilities. All the respondents had indicated that they wished to expand their production but due to lack of funds their intentions of increasing production remained wishful thinkings. Literature revealed that, small scale farmers have poor economic background or they do not have enough finance to state a project, so they need assistance to start a viable project. Financial support is needed at initial stages of production for buying inputs and labour, and for improving cultivation techniques and post-harvest care (Gabretsadkan 2015).

The amount of capital available determines the size of investment. Small scale farmers need financial support to grow their businesses because literature reveals that they make small profits, so little profits cannot be reinvested to make a big project without assistance (Gabretsadkan 2015). The results revealed that neither the government nor non-governmental organisations supported farmers financially. According to the RUAF Foundation (2007), there is no proper policy in Zimbabwe which supports mushroom farming. Mushroom production is side-lined financially from financial programmes which are given to other crops such as maize. The farmers do not have collateral so they cannot access loans

from banks and other financial institutions. The challenges on financial issues differ with countries; in China and Nepal the small scale farmers have full support from both government and NGOs. A study in Nepal observed that small scale farmers do not have a sound economic background but can access loans from banks at very small interest and can afford to pay back within few months (Poudel and Bajracharya 2011). Therefore there is need to have agricultural and economic policies in Zimbabwe to cater for the sustainability of small scale mushroom farming.

Markets

None of the mushroom producers had registered the mushroom business, so it is very difficult for them to sell their products to the market. Some reported that, the supermarkets want to deal with wholesalers not individuals. Supermarkets managers need police and tax clearance and demand large volumes of mushrooms which cannot be supplied by individual farmers. As a solution, 53.3% of the respondents have teamed up for a collective sale to the wholesalers while 17.7% of them said that they would negotiate with registered friends when they want to sell their produces. About 30% of the mushroom producers made sales to church congregants, schools and neighbours.

Price change in the market is another hindrance in the proper planning by mushroom producers. Respondents reported that prices for punnets and substrates had increased for no apparent reason and this had hindered their growing plans resulting in reduced production. Unexpected changes in substrates included costs of wheat straw which rose from $1.50 to $2. They also complained that the costs of packaging were high.

Lack of production place

Farmers from high density suburbs indicated that they needed more space for growing mushrooms and also for growing their substrates. Some reported that, they rent space from nearby farms which increases the operational costs.

Training

Formal training is done by government institutions, at higher costs than informal and private training organisations. Governmental institutions such as Universities and research centres such as SIRDC train mushroom producers and give them certificates but other organisations do not give certificates. Only 53% of the respondents were formally trained. Those trained went on to their respective areas and invited people who wanted to be mushroom producers and trained them in groups. Trained individuals indirectly trained their family members as they taught them how to carry out mushroom producing procedures. Respondents said that, they were not trained at institute level and would not do it because the cost of training is 5 times higher than the cost of training at the group level. Some respondents were born or married into families which practise mushroom production so there was no need for training. There is need by the government to revise their training charges so as attract or increase trainees' enrolment. The content cover of the group should include marketing strategies and information, and maintenance of records. These items seemed to be lacking in most mushroom producers.

Quality of spawns and substrates

The results showed that 36.7% of the respondents reported of poor quality of spawns. Mushroom producers have reported being deceived by private spawn producers and substrate suppliers. They also reported that some spawn suppliers, produce poor quality of spawns. Loss of confidence in the quality of the spawns has resulted in some farmers buying spawns from a variety of private spawn producers. Others preferred imported spawns. The deceived mushroom producers stopped using spawns from unregistered suppliers.

Temperature

About 30% of the respondents had challenges in monitoring temperature and 50% of them did not produce mushroom during very hot and cold seasons. They reported that hot weather dried up the mushrooms before they matured and cold weather delayed fruiting. Hence they only grew in rainy season or when the optimum conditions prevailed. The other 50% modified their structures to regulate temperature in different ways which included mounting structures with aluminium foil to reflect heat away. Some had structures roofed in iron sheets with a layer of thatching grass to act as an insulator. Proper training equips farmers with expertise to utilise technology in controlling physical factors such as temperature and to practice good hygiene when managing mushroom production (Gebretsadkan 2015).

Mushroom diseases

Mushroom diseases are one of the major factors that reduce productivity. Some mushroom producers treat green moulds by isolating and then throw away the infected bag while others use pesticides. Yellow and orange moulds were some of the reported diseases. Diseases are inevitable in mushroom production because the production is done under wet or dump conditions which are favourable for microbial growth. FAO (2008) revealed that small scale farmers face challenges in controlling diseases and a variety of pests including mushroom flies, weeds, different species of moulds and bacterial blotch. Beside diseases, some farmers reported on extreme temperatures which dry the mushrooms in case of heat wave and extreme cold seasons which delay fruiting and lengthen production time. Proper training equips farmers with expertise to utilise technology in controlling physical factors such as temperature and to practice good hygiene when managing mushroom production (Gebretsadkan 2015).

Water problems

Mushroom producers in high density suburbs such as Budiriro, Kuwadzana and in middle density suburbs such as Cold Comfort and Wesley, faced water problems. As a result, some producers were planning to install boreholes at their homes. Water availability is one of the physical inputs that play significant roles in mushroom production (Marshall and Nair 2009). Research reveals that maturing mushrooms require high moisture level which is attained by watering the growing rooms (SIRDC 2017).These findings showed that, water plays significant roles in mushroom production; hence farmers should consider clean water availability on production land before engaging in mushroom production.

Perishability of mushrooms

Mushrooms are perishable vegetables. About 6.6% of the respondents reported that, sometimes their harvests got bad before being sold. Some producers dry the mushrooms and some look for markets before the harvest to avoid losses. During the interviews, the respondents suggested that, buying and installing air conditioners and refrigerators would keep the mushrooms fresh.

Production trends

From the results of the analysis of the mushroom production in the peri urban and urban areas of Harare, shown in Table 1, the number of producers fluctuates and it is noted that 60% of the farmers' production is not constant. On mushroom production and profitability, the study results (Table 1) showed that more farmers resumed production in 2016 and the number tripled in 2017 in Harare urban and peri urban areas. The increase in mushroom farmers corresponds to increase in production. The observed results concur with the findings of Chiroro (2010). A marked decrease in the production and in the number of mushroom producers between 2014 and 2015 is an indication that some farmers had stopped cultivation due to some constrains. Some of the mushroom producers reported the following constraints: shortage of financial support, emergency of new diseases, changes in substrates and poor spawns. Inconsistency in

production was also noted in the Great Accra region (Frempong 2000). During the interviews, most farmers indicated that they stopped production for a year because of mushroom diseases, mushroom flies, change of spawns and substrates. There was a noted increase in production from 2014 (2652 kg) to 2017 (8400 kg) when comparing production figures of yearly average outputs (Table 1). There was a 217% increase in production for the production period 2014 and 2017. In a study carried out in Ghana on mushroom productivity, it was found that within five years (1995-1999), mushroom production (8592 kg in 1995 to 23508 kg in 1999) had increased by about 174% (Frempong 2000). Globally, mushroom production was noted to be increasing. From the results obtained in this study, it is safe noted that mushroom production in Zimbabwe is on the increase and is following the global trend.

Table 1: Annual outputs of mushroom (2014–2017)

Year	Farmers	Annual output (kg)	Average output (kg)	Sample standard deviation (kg)
2017	19	159600	8400	5826.5
2016	8	13320	1665	530.1
2015	5	4308	861.6	158.7
2014	9	23868	2652	1055.22

Source: survey data

Cash inflow

Table 2 shows yearly average cash inflows for the respondents. The table shows an upward trend in the total annual revenue starting from 2015. From 2014 to 2015, the revenue decreased by 81.95%, probably some farmers stopped farming due to some challenges. It increased by 209.92% from 2015 to 2016 then sky rocketed to an increase of 1098.2% between 2016 and 2017.

Table 2: Annual cash inflow

Year	Average price ($)	Average output (kg)	Average revenue ($) (Bt)	Annual revenue ($)	Revenue increase
2017	4.1	8400	34440	654360	1098.2%
2016	4.1	1665	6826.5	54612	209.92%
2015	4.1	861.6	3532.56	17662.8	-81.95%
2014	4.1	2652	10873.2	97858.8	

Source: survey data

Cash outflow

Cash outflow include the fixed or investment costs and operational costs. The fixed cost refers to the amount used for constructing mushroom cultivating/growing rooms and buying equipment that last longer such as drums. Most of the farmers did not construct mushroom growing structures; hence, low values were recorded on fixed cost. These farmers used structures which were already in existence. Some farmers modified the following properties for mushroom production purposes: old kitchens, fowl runs not in use and cottages. The use of modified structures reduces fixed costs. The results showed that, for the sample mean for the period of 2014-2017, the fixed cost was $164 while the operational cost was $245. Table 3 shows

yearly average cash outflow per farmer. The average cost per farmer was not constant, it changed each year. The farmers indicated that the costs of production materials are not controlled in Zimbabwe and are not constant. Some also said that, the cost of transporting the substrates varied with distance and place.

Table 3: Annual cash outflow

Year	Number of farmers	Average cycle	Total cost per year	Average cost per farmer (Ct)
2017	19	3	34950	1831
2016	8	3	12300	287.5
2015	5	3	6300	1260
2014	9	3	5700	633.3

Source: survey data

Costs, yields and selling prices

The observed costs incurred by the mushroom producers were the fixed cost and the operational cost. The average fixed cost for production per year was $164 and the estimated operational cost per annum was $245.The observed yield per producer per year was 1243.7 Kgs. The average selling price was $4.1 per Kg and the revenue generated per year was $5099.18. The selling price for individual customers was $1 per 200 g punnet and $0, 60 - $0, 80 to supermarket managers and whole sellers. The fixed costs included the cost of constructing, modifying structures and buying equipment. Little costs were incurred because the farmers constructed the structures themselves and most of the structures were already there and they simply needed modifications. This observation of using assets and facilities already in existence concur with observation done in Ethiopia where it was concluded that mushroom producers do use items which are not 'exclusive but rather assets which help to meet livelihood needs in general' (FAO 2008). A research in Thailand showed that housing structures which could hold 1000 bags could be built at low cost ($15) (Marshall and Nair 2009). All these studies indicate that the mushroom structures are built at low cost with locally available materials.

Yields and selling prices

The results for yields were arrived at by summing up individual yearly yields and then divide by the number of farmers to find the average yield. To find the yearly yield of a farmer, the cycle yields per farmer were summed. The revenue was calculated by multiplying the yield by the selling price. The farmers differed in their selling prices depending with the types of customers. For individual customers who do not buy in bulk, the punnet of mushroom (200 g) was sold for a $1 but for bulky buyers and wholesalers the selling price range was 60 to80 cents. The farmers had different numbers of cycles per year. Most of the peri urban area farmers practise once every year, while others 4 times a year. Most farmers preferred selling to whole sellers for fear of challenges faced during the debt collections. Poor methods of debt collection reduced revenue collected and project profitability.

Quantitative analysis

***Net Present Value* (NPV)**

The NPV is one of the financial methods used for evaluating the profitability of a project. It gives the present value of the future cash flows of a business. If the NPV is negative it means that the business is going to make a loss, if the value is zero, the project is not making any profit and when the NPV is positive, the project is worth investing in. NPV

was calculated using the average opportunity cost of 8% because most banks in Zimbabwe charge an interest rate of 8% per annum for short and long term deposits. The average NPV for the projects for the period 2014–2017 ranged from 2413.53–32744.63 . Despite different challenges faced by the farmers, the NPV was positive each year. In addition, the sample means NPV was positive, indicating that mushroom production projects are worth undertaking and are profitable.

Benefit Cost Ratio (BCR)

The computations for the Benefit Cost Ratio (BCR) revealed that, the average Benefit Cost Ratio for each year ranged from 2.51 to 23.74. The average BCR for the period of 2014–2017 was 15.75. All projects recorded a positive BCR; being positive is an indication that the farmers' investments in mushroom production were profitable.

Internal Rate of Return (IRR)

The IRR ranged from 38.6% to 355. 5%. The sample average was 141.42%. The computation of the IRR shows that, all projects had great returns on the investments made.

Hypothesis testing and analysis

On hypothesis testing, a linear regression was used to find out if there was a relationship between cost and revenue. A regression equation used to describe the relationship was

Yield (Kgs) = 616 + 2.08 Operational Cost ($).

From the results obtained, the p-values reject the null hypothesis that the coefficient is equal to zero. A small p-value < 0.05 shows that the null hypothesis is rejected (Frost 2013). From the results obtained, a small p-value indicates that changes in the operational costs (variable costs) are related to changes in the revenues (dependent variables) obtained. According to Frost (2013), a large p-value indicates that the results are insignificant and suggests that changes in the independent variables (operational costs) are not associated with changes in the dependent variables (revenues). The null hypothesis tested was: there is a relationship between operational costs and the revenue. Using the values obtained from the study, the p values were 0.477 and 0.35. These p values are too big as compared to 0.05. Therefore the p-values were insignificant suggesting that changes in the operational costs are not associated with the changes in revenue. We therefore reject the null hypothesis and accept the alternate hypothesis that there is no relationship between the operational cost and revenue. The farmers cannot use operational costs to predict revenues to be generated. This is because there are many factors that affect mushroom yields which include biological and environmental conditions, pests and diseases (Asemota et al. 2015).

Conclusions

It is pertinent to conclude that mushroom production in Zimbabwe is on the increase and is following global trends. The results of estimates of projects evaluations were all positive indicating that mushroom production projects were profitable. To maintain high yields that generate huge profits, mushroom producers indicated that they were in need of financial and training support from both governmental and nongovernmental organisations. Mushroom production in Harare urban seems to be at its infancy stages and a source of employment for the unemployed populace especially the youth. Mushroom production in Zimbabwe has great potential to contribute immensely to the economy and healthy of the nation if producers have the necessary support to deal with mushroom production and management problems.

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Conflicts of Interest

The authors declare no conflict of interest.

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