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Assessment of Production Constraints, Crop and Pest Management Practices in Peri-Urban Vegetable Farms of Botswana

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ABSTRACT

Enhancing the environmental soundness of agricultural practices, particularly in high input systems, is of increasing concern to those involved in crop production, agricultural research and development. This study assessed farmers' assets, production constraints, and farm and pest management practices of peri-urban vegetable farmers in Botswana. The study was meant to provide basic information that could be used to advice farmers, researchers and agricultural extension agents to improve the production of vegetable farming in the country. A random sampling procedure was used to select and survey 48 vegetable farmers across the country. The survey was carried out using a structured questionnaire. The study established that peri-urban vegetable farming is a male dominated business with more than 75% of the farmers at their prime age and with a good educational back ground (>52% received at least secondary school education). Water stress, pests, market and labour were among the major production constraints that the interviewed peri-urban vegetable farmers were facing. Vegetable production in the peri-urban areas of the country was intensive and pest management relied completely on the use of pesticides. Vegetable production ranked as the sole source of income for 50% of the interviewed farmers and one of the three main sources of income for farmers interviewed. It was also noted that majority (>54%) of the vegetable farms are managed by employed farm managers with little supervision from the owners. Although vegetable farming in Botswana is improving the living standard of farmers, there is need to encourage participation of females in the activity, improve the supply of inputs and reduce the overdependence on synthetic chemicals through development of integrated pest management strategies.

Keywords: Botswana, Peri-urban, Pest management, Production constraints, Water-stress

INTRODUCTION

The Horticulture Sub-sector in Botswana is considered one of the priority areas for diversification of the agricultural sector because of its important role in creating employment, investment opportunities and increasing agricultural sector contribution to the Gross Domestic Product (GDP) which has been declining since independence (Seleka, 1999; Anon, 2009). Despite its relative decline, agriculture has received substantial public support, geared at diversifying the sector. Farm level financial assistant incentives like Financial Assistance Policy (FAP) which operated from 1982 to 2000 (Rebaagetse, 1999), and the current Citizen Entrepreneurial Development Agency (CEDA) introduced in 2002 have attracted people to venture into vegetable production as a business. The other factor that might be attracting

people to venture into vegetable production is dramatic increase in urban population. Urban food needs, in cities of all sizes around the world are growing at twice the rate of rural areas (United Nations, 1997) and increasingly vegetables are grown in urban and peri-urban areas to meet the demand.

The 2008/2009 national demand for vegetable crops was estimated at 50 000 metric tons for vegetables, while local production for the same year was 31 150 metric tones. During National Development Plan 9 (NDP9) production per demand increased from 20% to 40%, while production for 2008/09 satisfied 51% of the national requirement (Anon, 2009). Despite this increase Botswana still imports fresh horticultural produce worth about P200 million mainly from the Republic of South Africa (TAHAAL, 2000). The market potential, therefore, offers the scope for increased vegetable production. These vegetable crops are produced in backyard gardens, commercial plots and recently in greenhouses of different sizes. A number of vegetable projects were implemented under the National Master Plan for Arable Agriculture and Dairy Development (NAMPAADD) program, including the Glen Valley Irrigation Scheme, which is intended to provide serviced agricultural land to farmers interested in undertaking commercial horticulture production (Anon, 2009). In 2008/09, 1906 tons of vegetables were produced and the scheme had created employment for eighty four workers. Still under the NAMPAADD Program, the Dikabeya Production Training Farm has been allocated an eight hectare plot, seven of which are already under cultivation, and 325 tons of vegetables were produced between April 2008 and March 2009 (Anon, 2009).

The government effort to increase horticultural production is constrained by among others endemic drought, poor soils, shortage of water, insufficient infrastructure, pest and disease outbreaks, poor farming practices, low adoptions of technologies, poor organisation of markets for domestic produce and lack of security of tenure. While government ministries may be aware of these constraints, it is important to carry out surveys that can provide the farmers alternative viewpoint on constraints facing them on their endeavour to produce vegetables. It is widely accepted that extension will be more robust when farmers' perceptions and practices are taken into account (Heong *et al*., 2002). There has been increasing interest in the incorporation of farmers' indigenous knowledge into agricultural research and development programs (Price, 2001; Nyeko *et al*., 2002; Isin and Yildirim, 2007; Obopile *et al*., 2008).

In this paper we present results of a survey conducted in an urban and peri-urban areas of Botswana. The objectives of the survey was to 1) assess farmers' knowledge and perceptions of various constraints to vegetable production; 2) identify crop and pests management practices of the peri-urban vegetable farmers.

MATERIALS AND METHODS

A fully structured questionnaire aimed at assessing the production constraints, farm and crop management practices of peri-urban vegetable farmers in Botswana was designed in June 2009. After a pre survey test on farmers in and around Gaborone, the questionnaire was refined with the addition of few questions from surveys conducted in Ethiopia, Assefa *et al*. (2008) and in Botswana, Seleka *et al*. (2002). The final version of the questionnaire was to interview 48 vegetable farmers, randomly selected from different peri-urban areas of Botswana (Fig. 1).

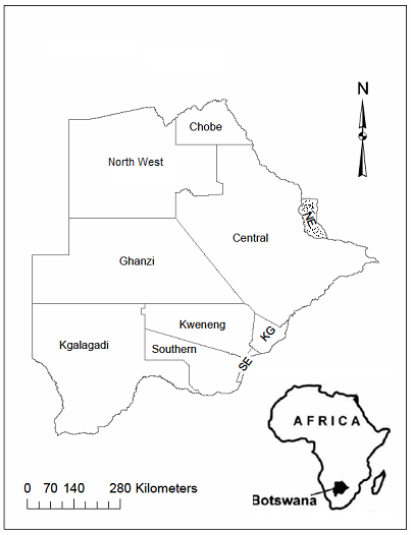

Fig. 1 Map of Botswana showing Districts included in the study. Shaded areas are not included in the survey. KG=Kgatleng, NE= North East, SE= South East.

Interviews conducted were carried out in English and/or Setswana for respondent who could not speak either of the languages.

Farm owners were interviewed on their farms. In the absence of the owner, the interview was carried out with the farm managers provided they had long experience and detailed knowledge on the farm management practices of the target vegetable farm. The responses to questions on age, educational background, vegetable production constraints, farm and pest management practices were recorded. For each question, the percentage of farmers who gave similar responses was calculated for each district and percentages calculated based on the total number of farmers who responded to each question. Those who did not respond to certain questions were excluded in the analysis. In instances where a farmer selected more than one reason, percentages were calculated for each group of similar responses. Data from the questionnaire were encoded, entered in Microsoft Excel 2003 spreadsheet and checked prior to analysis. Frequencies and percentage variable occurrences were calculated using cross tabulation (PROC FREQ), in SAS (SAS Institute, 2003).

RESULTS

Biographic and socio-economic characteristics

Summary of the biographic and socio-economic data are provided in Table 1 and 2. Over 81 percent of the respondents were male who indicated that they were principally responsible for farming activities. More than sixty percent of the respondents were younger than 40 years old and only 8.3% of them were older than 61 years (Table 1).

Vegetable farmers in the study area are dominantly literate with more than 52% of the respondents having at least secondary school education (Table 1). Land size ranged between 0.09 and 20 hectares, with an average land size owned by an individual farmer being 4.4 hectares (Table 1). More than half of the visited vegetable farms were managed by employed managers (Table 1).

Table 1: Biographic data and farm characteristics of farmers in the study areas

	Kgatleng	**Kweneng**	**Central**	**Chobe**	**SouthEast**	**Gantsi**	**Southern**	**Kgalagdi**	**Northwest**	**Average**
Farmer's										
Male	90	85.7	100	100	66.7	100	-	50	100	81.3
Female	10	14.3	-	-	33.3	-	100	50	-	18.8
Farmers										
<30yer	35	42.9	25	-	11.1	-	-	-	-	25
31-40yer	45	28.6	50	-	44.4	-	-	50	50	37.5
41-50yer	5	-	-	-	22.2	50	-	50	-	10.4
51-60yer	10	28.6	25	-	22.2	-	100	-	50	18.8
61yer+	10	-	-	100	-	50	-	-	-	8.3
School level										
None	10	28.6	-	-	-	-	100	-	-	10.4
Primery	15	28.6	-	-	-	50	-	50	-	14.6
Secondery	5	14.3	-	100	11.1	-	-	50	100	8.3
Teritary	65	28.6	100	-	88.9	50	-	-	-	43.8
Land size in hectars										
Average										
Range	4.4	3.3	5.7	10	5.4	6	2	0.2	4.7	4.4
	0.5-20	1-10	1.5-9.5	10	1.7-10	2-10	2	009-0.25	0.3-9	0.09-20
Who manages the farm?										
Ownener										
Employee	45	57.1	-	-	44.4	-	100	100	100	45.8
	55	42.9	100	100	55.6	100	0	-	-	54.2

There was a significant variation in land ownership between districts. The lowest proportion of the interviewed farmers without farm land ownership was recorded in Kgatleng (Table 2). In most of the districts interviewed farmers owned the land used for production while <30%) hired land to produce vegetables (Table 2). The source of irrigation water varied from district to district. Majority of interviewed farmers in Central district (75%) and all of the interviewed farmers in the North West (100%) district get their irrigation water from the river. A significant proportion of the respondents from Kweneng (42.9%), Chobe (100%) and Ghantsi (50%) depended on borehole for irrigation water. In South East district, vegetable farming is exclusively dependent on treated sewage water and most of the interviewed farmers in Kgatleng (90%) also depended on treated sewage for irrigation (Table 2). Few of the interviewed farmers (12.5%) get water from more than one source (Table 2). There is observed variation in irrigation methods between districts. Drip irrigation (39.6%) is the most common method used by the respondents (Table 2). Furrow irrigation was practiced only in Kgatleng and drag lines were reported only from Kweneng and southern districts (Table 2).

Table 2: Land ownership, sources and methods of irrigation practiced by farmers in the study areas

	Kgatleng	Kweneng	Central	Chobe	SouthEast	Gantsi	Southern	Kgalagdi	Northwest	Average
Owenership of land										
Own	50	85.7	100	100	66.7	100	100	100	100	70.8
Not owend	50	14.3	-	-	33.3	-	-	-	-	29.2
Source of water										
River	-	-	75	-	-	-	-	-	100	10.4
Dam	-	14.3	25	-	-	-	100	-	-	6.9
Borehole	-	42.9	-	100	-	50	-	-	-	10.4
Tap	-	14.3	-	-	-	-	-	50	-	4.2
Treated sewage	90	-	-	-	100	-	-	-	-	56.3
>One of the above source	10	28.6	-	-	-	50	-	50	-	12.5
Irrigation method										
Sprinkler	10	-	25	100	-	-	-	-	100	12.5
Drip	10	42.9	75	-	100	50	-	50	-	39.6
Furrow	60	-	-	-	-	-	-	-	-	25
Drag line	-	28.6	-	-	-	-	100	-	-	6.3
>One method	20	28.6	-	-	-	50	-	50	-	16.7

Farmers' perceptions of production constraints and ownership of equipment

Farmers listed a total of 12 constraints to vegetable production (Fig. 2). Pests were mentioned by more than 47% of the farmers as the major constraints followed by lack of labor (27.2%), water shortage (18.8%) and market accessibility (18.8%).

Other constraints like lack of capital, maintenance costs, transport, flood, land and inaccessibility of production inputs were also mentioned by 33.3% of the interviewed farmers (Fig. 2).

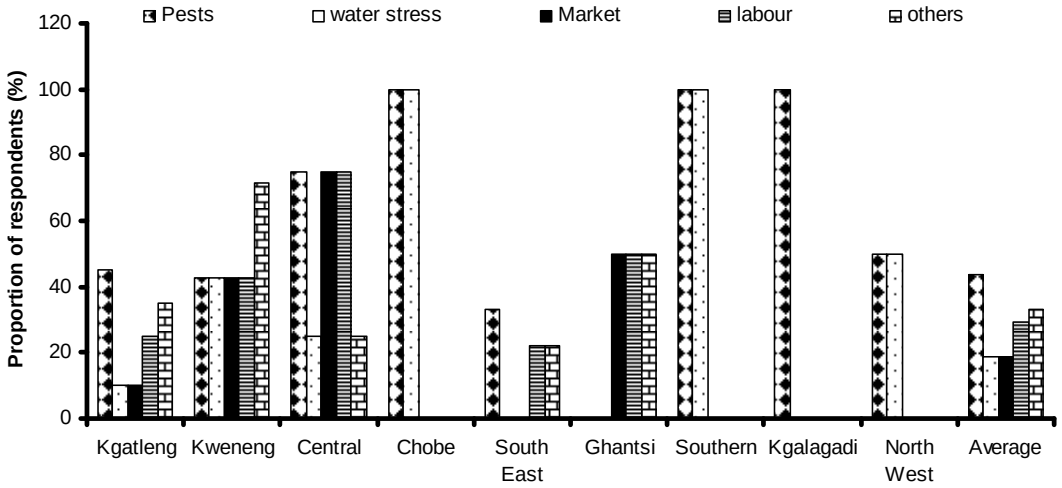

Fig. 2: Farmers' perception of production constraints in the study area

All the interviewed farmers have relevant farming tools like spade, rake, fork and hoe. A few interviewed farmers possess tractors (4.2%) and Knapsack sprayer was owned by almost all (97.9%) of the interviewed farmers (Fig. 3). More than 47% of the interviewed farmers owned water pump. Twenty percent of the respondents owned net shades and vehicles to transport vegetable produce to markets (Fig. 3).

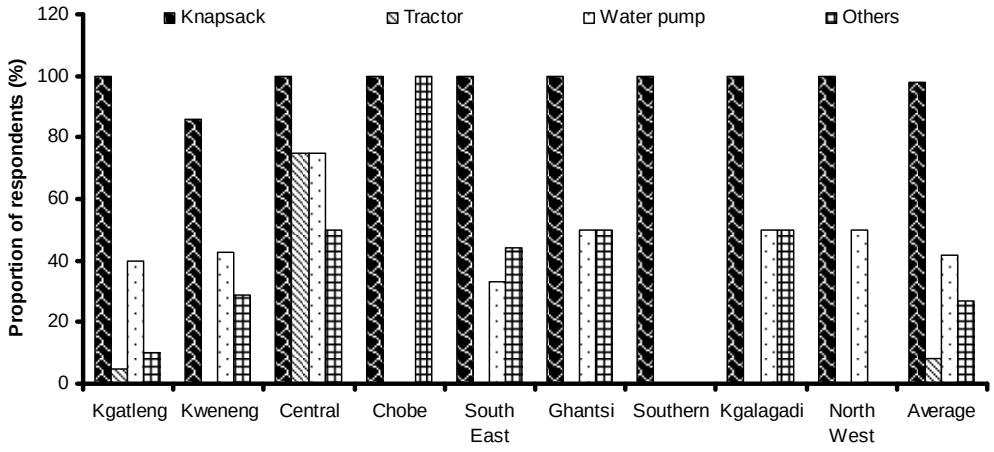

Fig. 3: Vegetable production equipments owned by farmers in the study area

Pest management practices

The use of pesticides was the common method that vegetable farmers used in management of insect and mite pests in all the visited districts. Out of a total of 48 farmers interviewed in this survey, only one farmer in the North West district practiced non-chemical method of insect and mite pest management. Hoeing is the most common method of weed management and it is practiced by 91.7% of the

interviewed farmers. Few farmers used herbicides (8.3%) and one of the respondents in the Central district used tractor for the management of weeds (Fig. 4).

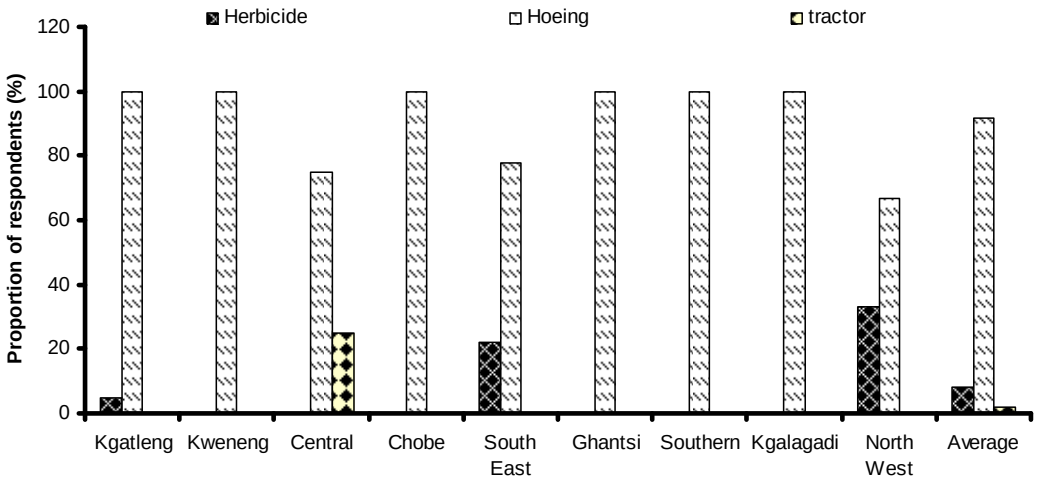

Fig. 4: Weed management methods practiced by farmers in the study area.

Sources of income

There was a significant difference in the role of vegetable production as an income generating activity between districts. All of the interviewed farmers in Southern and North West district exclusively depended on income from vegetable production for their livelihood. However, fewer farmers interviewed in Chobe and Ghantsi depended on the vegetable production for income. In general, vegetable production is a sole source of income for 50% of the interviewed farmers and a primary source of income for 16.7% of the farmers interviewed (Fig. 5). For the rest 18.8% of the interviewed farmers, vegetable production was used to supplement other sources of income. Fifteen percent of the interviewed farmers stated vegetable production as their third source of income (Fig. 5). The other sources of income mentioned by the interviewed vegetable farmers include pension, employment and livestock production.

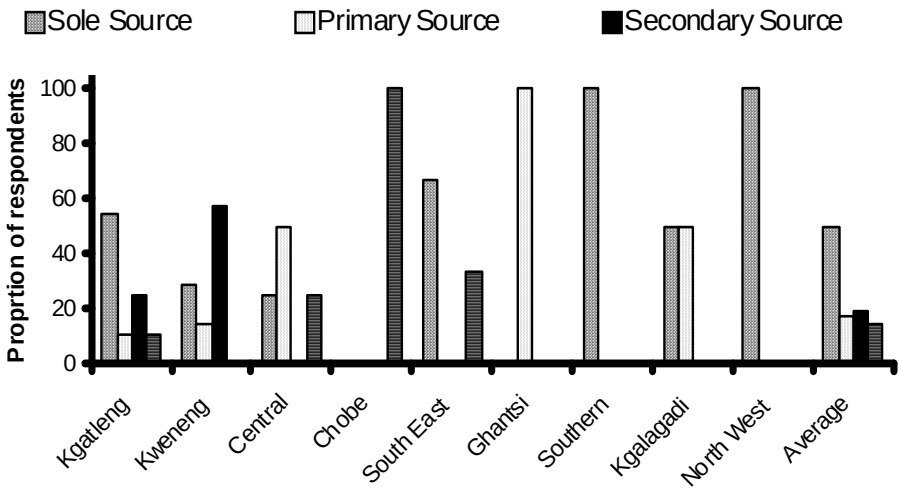

Fig. 5: Farmers' perception of vegetable production as an income generating activity in the study area.

DISCUSSION

Biographic and socio-economic characteristics

Results of the current study indicated that peri-urban vegetable farming in Botswana is a male dominated business with females represented by only 18.8% of the respondents. The results corroborate that of Obopile *et al*. (2008) who showed that 63% of vegetable farmers in Botswana were males. In contrast studied done elsewhere showed in Africa indicated that women dominated vegetable production. Agboola (2004) observed that rural women formed more than 70% of farmers enlisted in dry season vegetable production in southern Nigeria. The result of this survey is particularly worrisome in a country where large percentage of the population is female and several homes are headed by single female parents. Female farmers are reported to be equally efficient farm managers to their male counterpart **(**Quisumbing, 1996). It is therefore, important to encourage the involvement of women in the peri-urban vegetable farming to realize the countries objective of food security and alleviation of poverty for the large population of marginal input bracket residing in urban and peri-urban areas.

The observations on the educational background and age of vegetable farmers in this study are also opposite to what is commonly known of small-scale farmers in Africa. Most of the interviewed farmers in this study were literate and at their active age. This observation is not common in African small scale farming system (Kamara *et al*., 2001; Lewu and Assefa, 2009). Existing literature show that improved crop production strategies require high levels of expertise from farmers in order to be implemented effectively. Farmer practices have been shown to constrain performance resulting in low productivity (Crosby *et al*., 2000). Farmers who are better educated are generally more open to innovative ideas and new technologies that promote technical change (Lapar and Ehui, 2003). Educated farmers will also have a better knowledge of the benefits of adopting improved vegetable production practices and will more likely adopt the practice.

The trend in age distribution recorded in this study is also encouraging. One fourth of the respondents are less than 30 years old and another 48% are younger than 50 years. This implies that more than 70% of the farmers are in their active age (Lewu and Assefa, 2009). This contradicts with the results observed in Limpopo province of South Africa, where the average age of farmers was found to be between 53 and 61 years (Kamara *et al*., 2001). The lower age of vegetable farmers in Botswana may be explained by the introduction of Citizen Entrepreneurial Development Agency (CEDA) Young Farmers Fund in 2006 which attracted the youth to venture into agricultural activities (CEDA, 2006). The fund is available to Batswana aged 18-40 years with a P500, 000 loan ceiling. The objective of the fund is to encourage the development of competitive and sustainable youth enterprises in agriculture. It also meant to alleviate poverty and reduce unemployment among the youth. According CEDA (2010) report the fund approved 188 projects amounting to 76 million since its inception and horticulture attracted the highest number of 32 percent. Prior to the introduction of Young Farmers fund the mode age category or bracket was between 55 to 64 years, making farming mainly a domain of older people (Mlenga *et al*., 1997). The higher rate of educated and young farmer's involvement in peri-urban vegetable production is a good sign for the future of vegetable production in the country. Farmers' educational background and active labor have been reported to have significant positive effects on adoption of technologies (Das, 1997) and the

trend observed will contribute positively towards the attainment of the NDP 10 objectives of agricultural diversification and poverty reduction.

The high percentage of land ownership among vegetable farmers in the study area is not unfamiliar; as the Government policies are encouraging and citizens could easily acquire farm lands. The over 50% land ownership recorded in Kgatleng is not surprising either; due to the fact that many landowners rent the extra piece of irrigable land they own to urban and peri-urban dwellers from the country's capital city Gaborone. Land is the most important means of production and the extent of land owned is an indicator of physical asset endowment of a farmer. Private ownership of agricultural land reduces the cost of production, increases productivity and enhances technology adoption.

Majority of the vegetable farms in Kgatleng depend on treated sewage water from Gaborone for irrigation. Small scale farming communities in other areas use river and/or borehole. The method of irrigation practiced also varied with the source of water and districts. These variations in land ownership, source of irrigation water and irrigation method could have an implication on production cost, profitability of vegetable production and market prices of vegetable produce in the different districts. Research findings suggest that farmers' decisions to adopt new technology are dependent mainly on the quality of their land, access to irrigation, and profitability (Mukhopadhyay, 1994). The development of technologies in turn creates opportunities for a more efficient, competitive and profitable means of production in agricultural sector; and those who adopt these technologies faster are able to control the market than late adopters (Gurel, 1998).

Farmers' perceptions of production constraints and ownership of equipment

Identification of the key production constraints and provision environmentally-sound options for agricultural resource management is necessary to increase vegetable production in peri-urban farming communities in Botswana. The vegetable production system is relatively dynamic; however, the farmers' production goals are constrained by socioeconomic and biophysical factors; and that the system consists of interacting components. Pests, lack of labor, water shortage, market accessibility, lack of capital, maintenance costs, transport, flood and inaccessibility of production inputs were among the hiccups of vegetable farmers in the peri-urban areas visited. There is a need to improve accessibility of inputs, continued financial and technical assistance, training on integrated pest management (IPM) and stabilization of soil moisture status for sustainable agricultural productivity to meet the demands of the increasing population.

The ownership of advanced farm equipment in the peri-urban vegetable farmers is an indication of the level of prosperity and progressiveness of the farmers as compared to other small-scale farmers in Africa. However, these farmers are not completely independent and bear an extra cost of production due to lack of equipment for vegetable production. Nearly all of the farmers interviewed hire tractors to cultivate fields after which planting and hoeing was done by hand. This is a production constrain that ultimately increase production cost among African farmers who eventually find it difficult to compete in the formal commodity markets (Machethe *et al*., 2004). The ownership of basic farm implements by most of the vegetable farmers in this study on the other hand could have a positive influence on productivity. Studies indicate that capital assets like sprayers, vehicles, net shades and pumps add to the prosperity on the farm as well as marketable surplus of the farmer (Satish, 2005).

Pest management practices

Interviewed farmers in all the districts visited took insect and mite pests very seriously and exclusively used pesticides as they are fast, effective methods and easy to apply. Heavy reliance on synthetic pesticide are known to work well for several years but proves to be disastrous (Castella *et al*., 1999) in the long run. Over reliance on pesticides also results in spiraling pesticide input costs, increased pest problems and lower yields, which eventually make vegetable production uneconomic. Expertise regarding other pest control method is virtually non-existent in small-farming environments included in the survey. Only one of the interviewed farmers in the North West district practiced non-chemical means of pest management. The importance of improved agricultural production practices of which integrated pest management and other modern available technologies such as improved seed in attaining higher crop yields in Africa have been highlighted (Van Huis *et al.*, 1997) but these have unfortunately not found their way to the farm-level in vegetable farming communities included in this study. Long-term cropping systems research is important in order to reduce production costs to control vegetable pests, minimize the hazards from pesticides and to optimize the sustainability of agro-ecosystems. Integrated pest management (Furlong *et al*., 2008) and careful choice of seeds and seedlings will be some of the potential components for improving the vegetable production system in the country. Training on crop management and integrated pest management practices will improve the level of knowledge and farming performance of the vegetable farmers in the country.

Sources of income

Off-farm income has been pointed out to be part and parcel of subsistence farming in southern Africa (Aliber and Hart, 2010). The low level of reliance on own-farm income may contribute to low adoption rates of technologies that result in increased complexity of farming systems and that are perceived to add to labour requirements. Off-farm income has also been shown to be an important factor affecting technology adoption in Botswana where frequent competition between off-farm wage employment and arable production as well as interactions between different components of cropping systems and between crop and livestock production were observed (Edwards, 1982). Wage earners have a dramatic impact on crop production practices. It is well appreciated that many farmers in sub-Saharan Africa survive largely through remittances from family members working in industries unrelated to agriculture (Orr and Ritchie, 2004). Wage earners remit money which can be used to hire tractors, while their absence may also result in labour shortages at critical periods during the production season (Edwards, 1982; Flint, 1999).

In general, peri-urban vegetable farming in Botswana is improving the may contribute to uplifting living standard of farmers. However, there is a need to encourage participation of females in vegetable production, improve the supply of inputs and reduce the overdependence on synthetic chemicals through development of integrated crop and pest management strategies.

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