Journal of Development and Agricultural Economics

Full Length Research Paper

Python farming in Zimbabwe: Assessing local appetite for a novel agricultural system

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Python meat is a traditional but small source of protein throughout much of sub-Saharan Africa, but supply is exclusively from wild harvest. We build on recent evidence that supports snake farming as a viable and sustainable small-scale livestock system in Asia. We explore python farming as a strategy for enhanced food security in Zimbabwe. Our survey results highlight challenges, including drought and human-wildlife conflicts that face both traditional free-range livestock systems and food security, and reveal production prerequisites for complementary python farming. Preliminary findings suggest small-scale python farming could present a viable and sustainable complement to increasingly vulnerable traditional livestock systems.

Key words: Adaptation, sustainable agriculture, python farming.

INTRODUCTION

Global sustainability challenges facing agri-food systems include: zoonosis and the threat of infectious diseases; climate change; increasing demands for protein; diminishing land and freshwater resources; environmental concerns around waste; and social issues concerning food sovereignty (Rockström et al., 2003; Pretty et al., 2018; Henry, 2020). Impacts from environmental change and those implemented mitigation measures are disruptive and often disproportionately felt by industry stakeholders in tropical countries, where small-scale farming systems dominate but are disproportionately vulnerable to local weather, economic volatility, and market access barriers (Howden et al., 2007; Morton, 2007). Where traditional small-scale farming systems struggle to adapt to these changes, trailing of novel agricultural technologies and approaches has the potential to be transformative (Foley et al., 2011; Lipper et al., 2014; Nhemachena et al., 2014). In Asia, snake farming by small-scale farmers is a viable form of regenerative agriculture supporting food security and

access to trading opportunities (Aust et al., 2017a; LaCanne and Lundgren, 2018). This study aims to explore the feasibility of introducing small-scale python farming in Africa to address sustainability challenges facing the agricultural sector.

Snake production systems in Asia

The novel snake farming industry in Asia incorporates a wide range of species and production models (Natusch and Lyons, 2014; Aust et al., 2017a). Primary products include meat, skins and pharmaceuticals. The industry is evolving rapidly in accordance with advancements in captive production methods and globalized market demands. At present, production is dominated by small-scale farmers and low-cost production systems, but large-scale factory farms are increasingly evident (Aust et al., 2017a). Food inputs account for nearly two thirds of production costs. Cheap protein, such as wild-harvested rodent pests and locally available waste protein from agri-food chains (e.g., pork and poultry offal) are the most important prerequisites for commercial viability (Natusch and Lyons 2014, Aust et al. 2017a).

Burmese pythons (*Python bivittatus*) have been successfully bred and raised in an agricultural context for at least a decade. *Python natalensis* is in the same genus as *P. bivittatus* and displays similar life history traits (Reed and Rodda, 2009; Alexander, 2018). In Viet Nam, the socioeconomics of small-scale *P. bivittatus* production are broadly similar to ubiquitous backyard poultry production, the most significant difference being that pythons require a specialized high protein diet. However, this cost is offset by significantly better feed-to-carcass conversion ratios due to the ectothermic physiology of pythons (Pough, 1980, MacLeod et al., 2013).

Snake farming in Asia has additional commercial benefits including minimal land, freshwater and capital requirements (Aust et al., 2017a). Pythons have excellent food conversion ratios, rapid physical growth rates and high reproductive output (Secor, 2008; Reed and Rodda, 2009; Aust et al., 2017b). Furthermore, snakes have biological adaptations that build resilience in the face of environmental change, enabling farmers to synchronize operations with unpredictable environments by controlling rates of inputs and outputs (Secor, 2008, Urruty et al., 2016; Aust et al., 2017a).

Python production technology and practice transfer to Africa

Small-scale farmers in Africa and Asia face similar risks and opportunities (Otsuka and Sugihara, 2019). Approaches to livelihood security are often similar, and the universal success of small-scale poultry and

aquaculture are well documented (Wong et al., 2017; Kumar et al., 2018). Similar trends have emerged more recently with insect farming (Durst and Hanboonsong, 2015; Babarinde et al., 2020). Technology transfer between Africa and Asia is an important catalyst for commercial success, because novel, small-scale systems designed for tropical landscapes often solicit minimal interest or investment from western agribusiness (Kumar et al., 2018; Otsuka and Sugihara, 2019).

The southern African python (*Python natalensis*) is indigenous to Africa where it has never been farmed. Traditionally the species was coveted for its meat and medicinal value throughout much of the continent (FitzSimons, 1962; Klemens and Thorbjarnarson, 1995; Williams et al., 2016; Savage, 1844). There is currently no formal market for python products in Africa, and demand relies heavily on wild harvests (Taylor et al., 2015; Jensen, 2017). Available evidence suggests widespread legal and illegal trade in python meat, medicinal products, skins and as pets (Luiselli et al., 2012; Whiting et al., 2013; Jensen, 2017; D'Cruze et al., 2020).

Our survey was conducted in a region of Zimbabwe emblematic of many African small-scale farmers – multiple challenges and persistent need for improved food security and economic growth (Morton, 2007; Lipper et al., 2014; Nhemachena et al., 2014). Farmers are relatively well-educated and innovative, yet traditional and potentially unsustainable farming practices dominate (Mazvimavi et al., 2008; Baudron et al., 2012). Farmers generally have two primary income sources, cultivating dryland crops such as maize, millet and sorghum, and ownership of free-range herds of cattle, sheep and goats (Nhemachena et al., 2014).

A SWOT analysis in Table 1 summarizes the pros and cons of this approach. Most of our SWOT analyses are common considerations for all new agricultural approaches, but given some of the conspicuous advantages, why hasn't python farming been tested in Africa? Colonial legacies and knowledge gaps may explain part of this. Pythons were widely consumed as a traditional delicacy in pre-colonial Africa (Savage, 1844; FitzSimons, 1962; Klemens and Thorbjarnarson, 1995), but the introduction of colonial laws and Eurocentric cultural influences over the course of the 20th century banned or discouraged the consumption of many traditional foods (Singley, 2012; Alexander, 2014). In southern and East Africa, legal obstacles were enshrined in the Zimbabwe and Zambia [Rhodesia] Wildlife Conservation Act, 1960, South African Provincial Nature Conservation Ordinances, 1969; Tanzania Wildlife Conservation Act, 1974; Namibia Nature Conservation Ordinance, 1975; Botswana Wildlife conservation and National Parks Act, 1992. Furthermore, colonial wildlife legislation regarding pythons remains largely unchanged, and in Zimbabwe for example, the harvest and sale of

Table 1. SWOT analysis of snake farming as a novel agricultural system.

Strengths	Weaknesses
~90% more energy efficient compared to warm-blooded livestock	Lack of technical skills and knowhow
Minimal freshwater or land requirements	Risk of escape
Low start-up and running costs	Perceptions of local community
Drought tolerant	Potential to launder wild caught animals
Livelihood diversification	Willingness of farmers to take risks
Opportunities	**Threats**
Synergies with regenerative agriculture	Uncertain finacial returns
Demand for traditional animal protein	Regulation, licencing, permitting
Compatible with wildlife conservation	Captive-wild interactions in market
Resilient to climate change	Ethical implications of wildlife farming
Resilient to zoonotic disease threats	Lack of market development owning to quality perceptions and consumer acceptance
New market development	

python meat remains a serious criminal offence under the Zimbabwe Parks and Wildlife Act, 2014. Indeed, it is telling that South Africa is the only African nation to have reassessed the conservation status of pythons, and this resulted in the down-listing of the species to Least Concern (Alexander, 2014). This survey makes the assumption that the critical parameters for small-scale *P. natalensis* production in Zimbabwe would be similar to those for *P. bivittatus* in Viet Nam.

Python farming in Asia is an affordable and readily accessible livelihood option for small-scale farmers (Nossal et al., 2016; Aust et al., 2017a). It underpins food and livelihood security, environmental health and economic gains (Natusch and Lyons, 2014; Nossal et al., 2016; Aust et al., 2017a). There is currently no python farming industry in Africa and the widespread demand for python meat and traditional medicines is met solely through wild harvests (Whiting et al., 2013; Taylor et al., 2015; Williams et al., 2016; Jensen, 2017). Although the biological and commercial case for python production is well established, less well-known are the decision-making criteria for small-scale farmers and households in Africa to adopt this novel form of agriculture. This paper reports on results of a small survey exploring views on python farming as a potential compliment or alternative to increasingly vulnerable traditional livestock systems producing animal protein in rural Zimbabwe.

METHODOLOGY

Surveys were carried out in the Mabale ward on the border of Hwange National Park in the Hwange District of Western Zimbabwe. Hwange district is subject to frequent droughts and is considered one of the most food insecure regions in Africa (Nhemachena et al., 2014; World Food Programme, 2017). It has 750,000 citizens, 56% of whom are dependent on communal small-scale agriculture, mainly livestock and dryland crops (ZimStat, 2017). Wildlife based tourism is an important growth sector (Cumming, 2008), with the twin lures of Hwange National Park and the Kavango Zambezi Transfrontier Conservation Area.

We used a targeted sampling strategy and a semi-structured questionnaire (University of the Witwatersrand Human Non-medical Ethics clearance certificate: H17/11/03). Due to the hostile socio-political situation at the time of the fieldwork (concurrent with the 2017 Zimbabwe *coup d'etat*), local officials refused requests to conduct interviews with farmers. Instead, we conducted 31 face-to-face interviews with Village Heads from 31 of the 33 villages in Mabale ward. Village Heads are considered traditional authorities with an intimate knowledge of local livelihood issues (Musarandega et al., 2018). They are also important local decision makers and can play a key role in the uptake of novel agricultural technologies (Musarandega et al., 2018). Prior to the interviews, the researcher identified himself and informed interviewees of the concept and aims of the study. Time constraints necessitated abbreviation of the questionnaire, limiting questions to key sensitivies, perceptions and prerequisites for python farming (Appendix A). Interviews were monitored by government officials and each lasted approximately 30 min.

RESULTS

All respondents (n = 31) encountered problems with livestock farming as a local livelihood. Human-wildlife conflict was the most commonly reported threat (81% of respondents), with large carnivores cited as the main problem. Drought was the second most reported threat (68%), followed by water shortages (61%). Other threats included disease (39%) and a lack of grazing (13%).

Few large-bodied wildlife species remained permanently resident in Mabale ward, but sporadic incursions of large carnivores from Hwange National Park and seasonal migrations of mega-herbivores were common. The only indigenous protein resources reported to remain locally abundant included rodents (100%),

amphibians (26%) and invertebrates (100%). Rodents were more common now than 10 years ago (100%) and the only protein resource more common in crop fields than in natural habitat (100%). All respondents were aware of traditional methods used to trap rodents, as they were regarded as an agricultural pest. Rodents remained abundant for approximately eight months of the year (November to June, n = 31, $\overline{x}$ = 8, SD = 0.84).

Only four respondents reported having previously eaten python meat, but most (71%) said they had used traditional medicines derived from pythons. Over half of the respondents said they would readily eat farmed python meat (52%). All respondents believed the concept of python farming would be well received as a livelihood alternative because most farmers were struggling to sustain traditional free-range livestock. Three respondents reported that pythons were locally common and occasionally preyed on domestic livestock.

DISCUSSION

Previous studies have highlighted the shortcomings of conventional livestock systems in the arid human wildlife landscapes of rural Zimbabwe (Child, 2000; Nhemachena et al., 2014). Our findings, although preliminary, support the argument for considering a shift towards more sustainable alternatives, and provide evidence to suggest python farming could offer a solution for small-scale farmers faced with desertification and imperatives for wildlife conservation.

The conservation credentials and health risks of wildlife farming remain a contentious issue, with arguments both for and against (Lyons and Natusch, 2011; Nogueira and Nogueira-Filho, 2011; Cunningham et al., 2016). Although empirical evidence is lacking, initial indications suggest snake farming in Asia has net environmental and socioeconomic benefits, especially within the context of global change (Aust et al., 2017a). For example, the ease and low-costs involved in snake farming have undermined illegal wild harvests in China (Jiang et al., 2013), and the ectothermic physiology of snakes provides Vietnamese farmers with a biological barrier against frequent outbreaks of bird flu (P.A., pers. obs.). In fact, reptiles represent a barrier to the transmission of most viral zoonotic diseases, including H5N1-type flu, SARS, MERS, Ebola and COVID-19 (Magnino et al., 2009; Aust et al., 2017a).

Python farming in Zimbabwe may also create benefits at the landscape level. Communal farming areas are often characterized by deforestation, overgrazing, soil degradation, bush encroachment and illegal hunting (Child, 2000; Nhemachena et al., 2014). Increasing availability of protein at the household level is likely to displace some of the incentives to overstock, overgraze and poach wildlife, and thus lead to their reduction.

Cheap, locally available protein is the most important input in snake production systems. Rodents harvested in rice fields are an important source of feed input for python farms in Asia (Natusch and Lyons, 2014; Aust et al., 2017a). In Zimbabwe, increased demand for rodents to feed to pythons may generate opportunities for entrepreneurs to align ecological crop pest management with python farming. Trapping is an effective, chemical-free method of reducing rodent densities (Makundi and Massawe, 2011) and if left unchecked, rodents can have significant impacts on crop yields (Swanepoel et al., 2017).

There are some African countries where the python trade has faced fewer restrictions (e.g., Cameroon: Class B, Law 94/01 Regime of Forestry, Wildlife and Fisheries). This is particularly so in the Congo basin, were wild harvested python meat is often traded openly in informal food markets (Taylor et al., 2015; Jensen 2017). Supplying farmed python meat to bushmeat markets could potentially lower hunting pressure on threated bushmeat alternatives such as pangolins and chimpanzees (Fa et al., 2006; Nossal et al., 2016).

Despite being illegal for over 50 years, and the potentially incriminating circumstances of the interview process, the results of this survey suggest there is ongoing demand for python products in Zimbabwe, and potential exists for the emergence of a formal market. Python farming may represent a legal means of restoring and supply traditional food and medicine markets in Africa. As a livestock system, it is resilient to local environmental dynamics and could contribute meaningfully towards food and livelihood security.

Conclusions

This study reveals socioeconomic and environmental opportunities that could potentially be exploited through the implementation of a novel, pro-poor, climate-smart, and environment-friendly agricultural technology. If introduced judiciously, inclusively and at an appropriate scale, python farming could be transformative. Directly it could enhance food security, reduce poverty, foster livelihood diversification and restore culinary identity. Indirectly it could reduce anthropogenic impacts on biodiversity and disrupt the illegal bushmeat trade. However, before any conclusions can be drawn, the extent of any impacts – both positive and negative – would need to be monitored, analyzed and validated in an experimental capacity.

CONFLICT OF INTERESTS

All the authors have conducted research on reptile farming and the sustainable use of reptiles. Some of this

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APPENDIX A

1. Do you have problems with traditional livestock as a livelihood, if so what are they?
2. What resources (e.g. small animals) remain abundant in your area?
3. Where are these resources most abundant (e.g. in bush, in fields)
4. When are the peak times for these resources? (e.g. month, season)
5. Are there more or less of these compared to 10 years ago?
6. If there was a value/market for these resources, could you harvest them?
7. Do you eat snakes or use them in traditional medicine?
8. Would you ever consider eating snake meat?
9. If you could farm snakes for meat and skins (like chickens), would you consider them as an alternative to traditional livestock farming?
10. Do you think python would be a good or a bad idea? Why?