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PRESENT STATUS, CHALLENGES AND PROSPECTS OF SNAKE FARMING IN BANGLADESH

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Abstract: Venomous snakes are one of the most dreadful animals globally that kill their victims by injecting venoms (toxic substances) using fangs. However, snakes are being used for numerous vital life-saving purposes, including antivenom and traditional medicines, pain killers, cancer treatment, cardiac arrest, paralysis, arthritis, anti-ageing, and cosmetics to leather products, foods, display and research. This study was conducted to investigate the current status, challenges and prospects of snake farming in Bangladesh using self-structured questionnaires surveys. In this study, in total, 281 snakes belonging to 12 species i.e., common krait *Bungarus caeruleus,* banded krait *B. fasciatus*, greater black krait *Bungarus niger*, monocled cobra *Naja kaouthia*, spectacled cobra *Naja naja*, king cobra *Ophiophagus hannah*, russell's viper *Daboia russelii*, indian python *Python molurus*, common sand boa *Eryx conicus*, common cat snake *Boiga trigonata*, common wolf snake *Lycodon aulicus* and rat snake *Ptyas mucosa* were observed. This study also showed that the largest snake farm was at Patuakhali, where about 231 venomous snake individuals were reared, while 35 snakes were reared in Rajshahi farm, eight and seven snakes were reared in Rajbari and Gazipur farms, respectively. These snakes were collected from snake catchers/charmers and rescued from several places and nature. Snakes were fed on natural feeds (toad, frog, rat, and snake) and chickens. These farms had small to medium tin-shed building infrastructure with minimal facilities and used tanks, cages, and vivaria for snake rearing, breeding, and displaying. Snake farmers had not received any training, but some skilled snake handlers operated these farms. These snake farms did not keep managemental activities records and lack of proper design. These were not collected and preserved snake venom and were mainly involved in snake displaying. Although this study did not explore much information but snake farming may have great potential in Bangladesh; thus, more research is warranted on proper snake farming facilities. However, the government could be initiated the establishment of a modern and sophisticated snake farm for research, development, conservation, and venom collection including antivenom production and pharmaceutical purposes. Hence, the existing snake resources and skilled professionals may assist the government in snake farming activities.

Key words: Bangladesh, snake farming, potentiality, snake venom, antivenom, snake handlers.

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INTRODUCTION

Snake and its venom have always fascinated humans for their deadly biting ability as well as used as medical therapies (Powell *et al.*, 2006, Mukherjee et al., 2013), superstition, rumor, appearance (eyes without nictitating membrane) (Koh et al., 2006). They have the defensive sound ability, cryptic expression, swiftness, hiding ability and adaptability in almost all habitats. Snakebite in Bangladesh is one of the most common but neglected occupational health hazards, where the death rate is grossly around 1600 (Hafiz, 2017), 6041 (Rahman *et al.*, 2010) and 1709 (Hossain *et al.*, 2016) persons per year. In Bangladesh, appropriate information on snakebite is not available due to the lack of a proper recording system, information gap, lack of awareness (Alam *et al.*, 2014), the unwillingness to admit to hospital, disrupted communication, beliefs in traditional medicines, *Ozha*, *bede* and a talisman (Amin, 2010). Globally, about 1.8-2.7 million snake bites occur per year with a maximum mortality range of 80,000-138,000, and 300,000 suffer from physical disabilities, stigmatizing disfigurement, and chronic mental disorders (Calvete, 2019). The actual global incidence of snakebite, envenomation and mortality due to envenomation would be very difficult to say due to the paucity of data as most of the snake bites are occurred in rural areas of developing and under-developing countries where recording system is totally absent or very poor (Kasturiratne *et al.*, 2008). It appears that the most standard treatment for snakebite, both western and traditional/herbal, appear to be harmful and unfortunately, the highest death due to snakebite envenomation occurs in South Asia (Warrell, 2010). Snake venom contains phospholipases, metalloproteinase, serine proteinases, C-type lectins and disintegrins (Braud *et al.*, 2000; Koh et al., 2006). The venom of one species of venomous snake contains hundreds of proteins and toxins, and it can be assumed that 725 species of venomous snakes in the world sustain a vast amount of poisonous toxins and proteins, but most of them are still now uncategorized (Ojeda *et al.*, 2017; Calvete, 2019). Different classified venoms from different venomous snakes have many potential therapeutic activities such as antibacterial, anti-parasitic, antihypertensive, antitumor, anti-parkinsonian anti-inflammatory analgesic, anti-diabetic, antipsychotic, anti-depressant, anti-cancer, anti-histamine and anti-malaria (Nicolau *et al.*, 2018). Snake venom contains numerous biochemical properties such as proteins, enzymes, peptides, carbohydrates and lipids, biogenic amines, zinc, cobalt, nickel, iron, manganese, sodium, calcium, potassium, magnesium (Hider *et al.*, 1991). Using natural products goes back to the same period of human evolution (Mladic *et al.*, 2020). In Chinese traditional medicines, snakes' blood and bile ducts have been widely

used (Koh *et al.*, 2006). Some of the FDA (U.S. Food and Drug Administration) approved drugs used captopril clinically from pit viper, tirofiban from saw-scaled viper and integrilin from pygmy rattlesnake (Lazarovici, 2020). In Bangladesh, the demands and uses of snake venom in therapeutic diseases are still unknown.

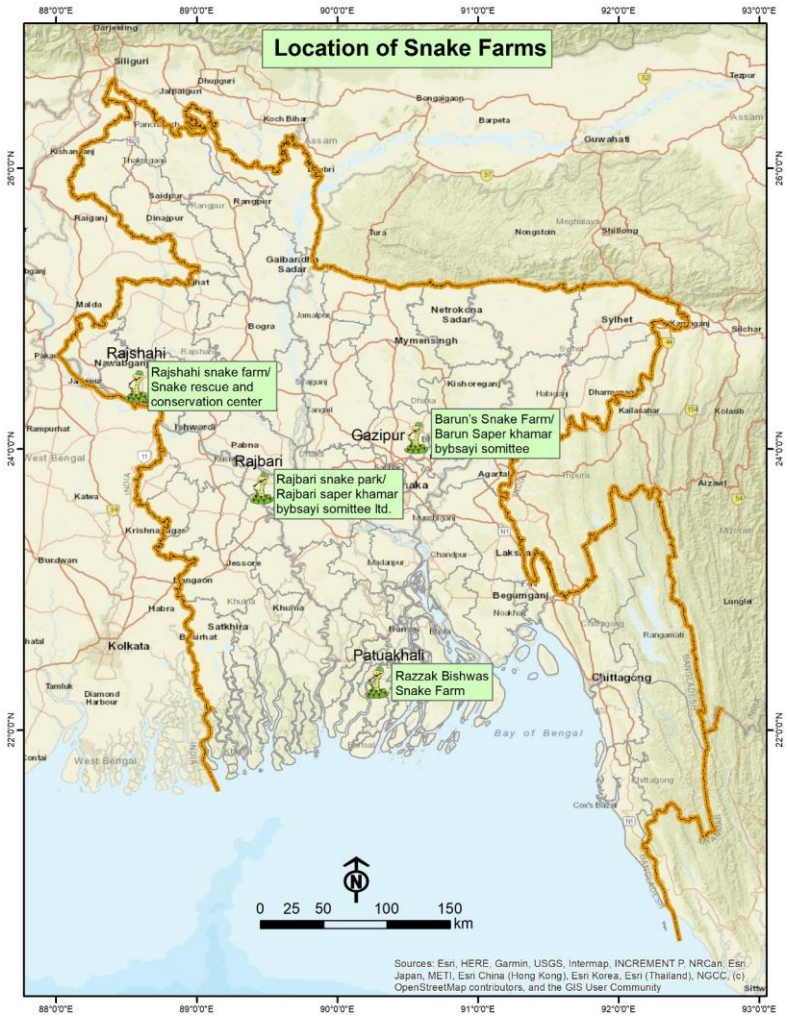

Fig. 1: Positions of the four snake farms in Bangladesh

Venom extraction from snakes in the prevailing industry is not easy; it is confidential and dangerous (Powell et al., 2006). Antivenom is the only scientifically approved therapy for snake envenoming by a venomous snake (Calvete, 2019). High-quality antivenom is severely scarce in many developing

and under-developing countries due to unavailability and unaffordability (Habib, 2018). Currently, Sri Lanka, Bangladesh, Nepal, Bhutan, Pakistan and Indian are is used the polyvalent antivenom for snakebite treatment (Kalita and Mukherjee, 2019). Therefore, snake farming and snake park have become popular globally for the high demand for snake venom and derivatives.

The standard ASV (Anti Snake Venom) used in the Indian subcontinent neutralizes only four snake species, namely common krait *Bungarus caeruleus*, russell's viper *Daboia russelii*, saw-scaled viper *Echis carinatus* and cobra *Naja naja* (Amin, 2010., Whitaker and Whitaker, 2012). However, other venomous species have significant importance of snakebite whether ASV could be insufficient, especially in *Naja kaouthia, Ophiophagus hannah* and *Bungarus fasciatus* (Menon *et al.*, 2017).

Since ancient times, people have been using snakes, its venoms, and other derivatives for hundreds of traditional and modern medicinal and other purposes. Combining venomics, transcripotomics, proteomics, recombinant protein and peptide synthesis, and interdisciplinary research will develop a future drug from snake venom (Lazarovici, 2020) to treat complicated diseases. Rearing undomesticated animals for captive breeding purposes and producing them commercially are defined as wildlife farming (Nogueira and Nogueira-Filho, 2006). Commercial snake farming is getting popular in some Asian countries like China and Vietnam for multiple uses of snake derivatives and getting sustainable due to easy farming, profitability, and creating less pressure on wild harvesting (Aust *et al.*, 2017). Snake farming is gaining momentum for its market value in the skin, meat, venom, pet and medicine (Konar and Modak, 2010). Initiation of commercial snake farming in Bangladesh is definitely for economic purposes, but the exact reasons, aims, or goals of these snake farming and venom or snake derivatives demands in the local market are unknown.

Globally, snake venom and its derivatives demand more research because of their diversified biological functions, inflammatory properties and interaction with sensory neurons, which are yet to be explored. In the last two decades, some young and enthusiastic people in Bangladesh have established snake farms inspired by sources such as youtube, blogs and social media. They have been collecting snakes from snake catchers/charmers and nature and kept them in their establishments for rearing and displaying without maintaining any protocol of the Forest Department. Venomous snake farming is not like other animal farming, and it needs proper knowledge, sophisticated set-up and technics. According to the Wildlife (Conservation and Security) Act 2012, all snakes are protected in Bangladesh. The Forest Department is the only custodian to look after them and rearing or collecting any snakes or derivatives

demands their prior permission. The present study deals with the investigation of existing traditional farms closely and finds out their current status, prevailing challenges and future prospects from the perspective of Bangladesh.

MATERIAL AND METHODS

Four existing snake farms in four districts (Rajshahi, Gazipur, Rajbari and Patuakhali) of Bangladesh (Fig. 1) were visited from June 2017 to May 2019 to collect data on existing traditional snake farming (Table 1). Direct observations of snakes and personal communication with farm owners were conducted to collect information on the prevailing snake farms through self-structured questionnaires.

Direct observations included personal interviews of snake farm owners, observing the snake species, the infrastructure of the farms, snake display and snake rearing cages, feeding and breeding-related information on the farms. Information regarding the collection methods of snakes and their sources was gathered from the farm owners' personal interviews and the species were identified following Whitaker and Captain (2004). One 6-meters measuring tape was used to measure the rearing cage, tank size, and snake farmhouses. Purposes and motives of establishing snake farming information were collected directly from the farm owners and cross-checked with the local peoples of the same field and experts. Feeding and breeding are the most crucial parts of any farming. The farm owners were interviewed as well as direct observations were made to collect data on the supplied food items, food collecting sources, and breeding techniques. Snake collection sources, venom collection, public-private investments, aims, and license authenticity regarding snake farms were known through interviewing the farm owners. Present data on snake farming in Bangladesh were compared wherever necessary with prevailing available data from the published scientific journals (Alirol *et al.*, 2010, Aust, 2015, Aust *et al.*, 2017, Warrel, 2010 and Powell *et al.*, 2006).

RESULTS AND DISCUSSION

The present study covered four snake farms from four districts under three divisions of Bangladesh (Fig. 1 & Table 1). These very small to medium-sized and self-designed snake farms were reared snakes in their established houses within brick walls, concrete or earthen floors and corrugated tin roofs (Plate 1). The main purpose of snake farm owners was to promote ecotourism and venom production without having proper licenses from the government authority. These farms were established between 2008 and 2016 within 30 to 60 decimal areas,

initially with 45 to 247 individual snakes (Table 1). Snakes were mostly collected from snake catchers/charmers and nature, but the authority of Rajshahi snake

A: Providing food to snakes in Razzak Bishwas'sSnake Farm

B: Snake display centre at Rajbari Snake Farm

C: Snake Rescue and Conservation Centre, Rajshahi

D: Snake rearing tank of Snake Rescue and Conservation Centre, Rajshahi

E: Snake rearing hole of Snake Rescue and Conservation Centre, Rajshahi

F: Snake rearing tank of Barun'sSnake Farm, Gazipur

Fig 2. Rearing snakes in the existing farms of Bangladesh

Farm collected all snakes either from houses and/or gardens of the residential areas as a rescuer. The farms had 2 to 7 species of snakes, of which, most of them were cobras (*Naja naja, Naja kaouthia*). The number of snakes in those

four farms was 7 to 231 individuals during the study period (Table 1). The total number of snakes on the farms was less than the initial time due to the death in captivity.

Razzak Biswas's Snake Farm of Patuakhali District was the largest among these four snake farms in Bangladesh, whether 231 individual snakes existed, and while Barun's snake farm of Gazipur was the smallest, with only 7 individuals. Rajshahi and Rajbari snake farms were comparatively moderate in size in terms of snake rearing and management. The exact motives and aims of these farms in Bangladesh are not clear because of lack of the confirmation and licenses from proper authorities. Currently, there are more than 35 antivenom manufacturers producing monovalent antivenom (useful for single species bite) and polyvalent (effective for multiple species bite) available in the World markets (Powell *et al.*, 2006).

Nevertheless, there are at least 4000 up to 4500 small to medium-sized commercial snake farms operating globally to meet the world demand for snake derivatives (Aust *et al.*, 2017). The number of species in extraction facilities is between 50-1500 animals (without co-operative community-based management), and they broadly fall under three families: Colubridae, Elapidae and Viperidae (Powell *et al.*, 2006). All the snake farms in Bangladesh were reared and displayed snake species in small establishments of 1-19 tanks. Razzak Biswas's Snake Farm had one tank, 156 cages, and one vivarium for rearing snakes inside the farm. Other farms reared the snakes solely in the tanks, but they had some cages for collecting and displaying snakes. Probably snakes are the species; which are reared or kept in a very confined area of vivaria or racking system for a pet, displaying, breeding, farming and researching by snake keeper or snake handler (Warwick *et al.*, 2019). Three snake farms **(**Razzak Bishwas's Snake Farm, Rajbari Snake Farm, Rajshahi Snake Farm) in Bangladesh had a minimal breeding program with their limited set-up on a trial basis, but any successful breeding of these snakes demands related experts and functional biology study. Hatchlings need particular types of care and foods, which are absent on these farms. More than fifty percent of the venom extraction facility has a captive breeding program, and monoculture production would not be the best choice (Powell *et al.*, 2006).

A total of 12 species of snakes were observed and categorized as venomous snake (seven): common krait *Bungarus caeruleus*, banded krait *B. fasciatus*, greater black krait *B. niger*, monocled cobra *Naja kaouthia*, spectacled cobra *Naja naja*), king cobra *Ophiophagus hannah*, russell's viper *Daboia russelii*; non-venomous snake (four): python *Python molurus*, common wolf snake

Table 1: Details of the snake farms in Bangladesh

Sl No	Detailed information on the snake farms	Name of the snake farms			
		Bangladesh Snake Venom Popularly known as: Razzak Bishwas's Snake Farm	**Rajbari Saper Khamar Popularly known as: Rajbari Snake Farm**	**Snake Rescue and Conservation Centre Rajshahi Popularly known as: Rajshahi Snake Farm**	**Barun-er Saper Khamar Popularly known as: Barun's Snake Farm**
1.	Farm owner's Name(s)	Abdur Razzak Bishwas	Robiul Islam Ronju	Borhan Biswas Roman	Prodip Das, Kawsar Sarker & Masud Alam
2.	Farm Location	Vill.: Nandipara P.O.+P.S.: Patuakhali Sadar Dist.: Patuakhali	Vill.: Gazaria Bill Upazila: Kalukhali Dist.: Rajbari	Vill.: Dharmohata Upazila: Paba Dist.: Rajshahi.	Vill.: Barun Upazila: Kapasia Dist.: Gazipur.
3.	GPS Coordinate	22^{0}20' 22.22" N, 90^{0} 16' 40.00" E	23^{0}43' 18.80" N, 89^{0} 27' 30.75" E	24^{c}26' 50.03" N,88^{c} 34 14.31" E	24^{0}04' 49.90" N, 90^{0} 33' 31.76" E
4.	Date/Year of Establishment	2008	2013	2009	2016
5.	Objectives of the snake farm	Ecotourism, Venom production	Ecotourism, Venom production	Ecotourism, Venom production	Ecotourism, Venom production
6.	Farm area	60 Decimal	35 Decimal	30 Decimal	33 Decimal
7.	Total man power/staff	4-5	03	3-4	03
8.	Maintain safety rules with essential equipment	No	No	No	No
9.	Farm management record keeping	Not well documented	No	Not well documented	No
10.	Snake expert involved	No	No	No	No
11.	Snake farm design by	Self	Self	Self	Self
12.	Trained from Govt/Private organization	No	No	No	No
13.	Size of the farm house/shade	Length 762 cm & Width 336 cm (Brick wall with corrugated tin roof)	Length 915 cm & Width 397 cm (Brick wall with corrugated tin roof)	Length 793 cm & Width 549 cm (Brick wall with corrugated tin roof)	Length 610 cm & Width 458 cm (Brick wall with Tin roof)
14.	Number of the snake rearing tank	01	13	19	02
15.	Snake rearing tank size	Length 183 cm, Width 92 cm, Height 107 cm	Length 77 cm, Width 77cm, Height 122 cm	Length 61-305 cm, Width 61-183 cm, Height-153 cm	Length 183 cm, Width 153 cm, Hight 153 cm
16.	Number of snake rearing cage	156	0	0	0
17.	Snake rearing cage size	Length 61 cm, Width 24 cm, Height16 cm	0	0	0
18.	Total Number of snake specimens (during establishment period)	247	45	98	56
19.	Total Number of snake specimens (study period)	231	08	35	07
20.	Total Number of snake species	03	05	07	02
21.	Name & Number of snake species	1. Monocled cobra (*Naja kaouthia*)-172 2. Spectacled cobra (*Naja naja*)-58 3. King cobra (*Ophiophagus hannah*)-1	1. Common krait (*Bungarus caeruleus*)-1 2. Greater black krait (*Bungarus niger*)-1 3. Spectacled cobra (*Naja naja*)-3 4. Python (*Python* sp.)-2 5. Common sand boa (*Eryx conicus*)-1	1. Common krait (*Bungarus caeruleus*)-2 2. Banded krait (*Bungarus fasciatus*)-1 3. Russell's viper (*Daboia russelii*)-1 4. Spectacled cobra (*Naja naja*)-27 5. Common cat snake (*Boiga trigonata*)-1 6. Common wolf snake (*lycodon aulicus*)-1 7. Rat snake *(Ptyas mucosa)*-2	1. Monocled cobra *(Naja kaouthia)-6* 2. Spectacled cobra *(Naja naja)*-1
22.	Snake collection sources	Snake catchers/charmers & Nature	Snake catchers/charmers & Nature	Snake rescue & Nature	Snake catchers/charmers
23.	Snake breeding activity	1. Monocled cobra (*Naja kaouthia*) 2. Spectacled cobra (*Naja naja*)	1. Common sand boa (*Eryx conicus*)	1. Banded krait (*Bungarus fasciatus*) 2. Spectacled cobra (*Naja naja*)	No
24.	License from	Forest Department- No Fisheries and Livestock Department- Yes Co-operative Society- Yes	Forest Department- No Fisheries and Livestock Department-No Co-operative Society- Yes	Forest Department- No Fisheries and Livestock Department- No Co-operative Society- Yes	Forest Department- No Fisheries and Livestock Department- No Co-operative Society- Yes
25.	Public-private investment	No	No	No	No
26.	Investment cost (shed, tank, snakes, etc.)	Not well documented	Not well documented	Not well documented	No documented
27.	Snake venom milking activity and preservation	No	No	No	No
28.	Food items for snake	Snake Toad Frog	Common house gecko Toad Frog	Snake Toad Frog Chick	Toad Frog Rat
29.	Farm income sources	Snake Display and YouTube Channel	Snake Display	No	No

Lycodon aulicus, rat snake *Ptyas mucosa*, common sand boa *Eryx conicus*; and mildly venomous sanke (one): common cat snake *Boiga trigonata*. It is very necessary to develop a list of snake species based on available scientific literature, voucher specimens, and direct and indirect surveys in some regions to confirm the inventory and categorize the snake species list according to venomous, non-venomous, commercially important (according to venoms, growth rate, skins, availability and vulnerability), pet snakes and exotic snakes.

According to WHO (2010), venomous snakes are categorized into two categories: Category-I species (most widespread and common causes for mortality) belong to Elapidae (*Bungarus caeruleus, B.niger, B.walli* and *Naja kaouthia*) and Viperidae (*Cryptelytrops erythrurus*), and Category-II species (lack of data and less common of mortality) belong to Elapidae (*Bungarus facsiatus, B. lividus, Naja naja* and *Ophiophagus hannah*) and Viperidae (*Cryptelytrops purpureomaculatus, C. septentrionalis* and *Daboia russelii* (Warrell, 2010). Cobras, kraits and vipers are the main reasons for snakebite envenoming in Bangladesh (Alirol, 2010).

Almost all provisioned foods i.e., frogs, toads, snakes, common house gecko, and rats were collected from nature except chicks (Table 1). They were provided food once a week or fortnightly as per season. Food intake of snakes is fallen under three categories: (1) wild-harvested natural food (e.g., amphibians and rodents), (2) waste proteins from existing industries (e.g., poultry and pork), and (3) formulated diets (e.g., processed waste protein) and feeding rate is usually 10% of body weight per week (Aust, 2017). Wildlife farms should have species-specific formulated food sources for snake rearing instead of depending on the natural sources. Species-wise monitoring system of food intake and their physical requirements were lacking on these farms.

Venom extraction facilities were also lacking in the existing set-up for milking the snake species (Table 1). Venom extraction is the first and foremost condition of venom collection which varies according to the species, size, types, and availability of the technicians' skill; categorized into voluntary (natural stimuli applied), involuntary (artificial various mechanical forces are used), and gland extraction (remove entire poison gland) (Hayes and Nelsen, 2020). The staff of these farms is not well equipped for venomous snake rearing or rescuing and they are doing these risky jobs with unprotected hands and feet. Venomous snake-handling needs proper tools, techniques, training, experience, knowledge of snake behavior, and response to stimuli (Lock, 2008). The snake venom extraction in industry is not easy that is confidential and having high risk to snake bites (Powell *et al.*, 2006). Maximum snake handlers of these farms had some skills and experience in snake handling and capturing, they did not

receive proper training from any institution (Table 1). People from their districts and other districts call them to rescue snakes rather than kill them nowadays, which is a common practice in Bangladesh. There should be scientific protocols and guidelines on snake farming, research, live display and rearing according to the species, geography, national and international demands, social perspectives and available scientific literature. Proper rules and regulations are prerequisites on commercial snake farms for proper places, infrastructures, training, facilities, techniques, equipment, hygiene, skilled technicians, financial support, and medical emergency facilities.

None of the four farms had a license from the Forest Department of the Bangladesh Government, which is the sole authority of premising wildlife farming (Table1). They are operating their farms in the name of a co-operative society. Rajbari Snake Park/Rajbari Saper Khamar Babsayee Somite Ltd., Rajshahi Snake Farm/Snake Rescue and Conservation Centre, Rajshahi, had faced several raids from Bangladesh Forest Department. After raiding farms, they stopped collecting and displaying snakes for some months, but they did not give up snake collection through the rescued system. These farmers are famous in their localities as snake rescuers. Future potentiality is very ambiguous for these farms because they do not have any license, safety measures, expert(s), minimum man-power (total 3-5) and scientific set-up for sophisticated commercial farm operations (Table 1), but they are self-skilled in snake handling and displaying. Existing snake farms, farmers, and venomous and nonvenomous snakes should be under Government proper guidelines and monitoring systems and evaluated by the concerned experts before facilitating and licensing them for commercial production. The production of undomesticated animals would be efficient if they were reared scientifically and sustained the scope of available scientific research (Nogueira and Nogueira-Filho, 2006). Food consumption, reproduction, growth rate, space requirement and early maturity are the prime criteria for rearing some species such as *Naja atra, N. kaouthia, Ptyas mucosus* and *Ophiophagus hannah* (Aust *et al.*, 2017). The income generation for Razzak Biswas's Farm was from snake display and loaded several videos on the YouTube Channel whether Rajbari Snake Farm was only snake display and the two other farms do not have any income generation way. None of these farms was maintained or supported by government organizations regarding scientific measurements and precautions. They do not even follow experts' opinions or specific protocols for species collection, health, hygiene, safety, feeding, breeding, or rearing the snakes. Existing available snake farmers could be facilitated in a government-initiated research project to train them to rescue and handle venomous snakes and awareness programs as

well as creating a venomous animal's research and display center for facilitated biological, pharmaceuticals, biotechnological research, training and conservation outreach programs.

CONCLUSION

Rearing snakes in private enclosures and displaying them to the public to earn money is an ancient tradition in Bangladesh. However, it was solely confined to the snake charmers. Commercial snake farming is not older than 20 years in Bangladesh. They have very limited infra-structures and facilities for operating commercial farms, and even they do not have the proper license from the Bangladesh Forest Department. Snakes have been housed in the unhygienic limited small structure tin-shed building and none of these farms has proper safety measures, instruments, and facilities for rearing deadly venomous snakes. They collected these snakes from snake catchers/charmers or rescued some of them from several places and almost all of their provisioned foods from nature. They are rearing and operating farms without proper scientific knowledge, experts, aims and goals. However, the potentialities of these farms are that many snake farmers have remarkably skilled in snake handling, operating, and displaying. They rescue snakes from their localities and two farms have a limited income source by displaying different snakes to the public, including several videos loaded on the YouTube Channel. Indian polyvalent antivenom is used in the South-Asian countries as antivenom, but the country needs its own antivenom production from the venoms of local snakes to overcome geographical species barriers for effective snake bite management.

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