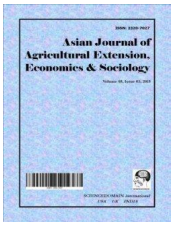

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Profiling of Chinese Mitten Crab Farmers in the Jiangsu Province of China

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Authors' contributions

This work was carried out in collaboration between all authors. Author HA designed the study and wrote the first draft of the manuscript including literature review. Authors HA, XY, ZZ and WZ designed the questionnaire for data collection. Author HA analyzed the data while all authors discussed the results. All authors read and approved the final manuscript.

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ABSTRACT

Profiling of Chinese mitten crab (*Eriocheir sinensis*) farmers is relevant for policy development and successful implementation of projects. Few studies have been undertaken in this area of research. The object of this study is to profile farmers involved in the production of *Eriocheir sinensis* farming in Jiangsu province, China. Data were collected using structured questionnaire. Results show that most farmers have attained basic education. The average age of farmers is about 57 years. The main occupation of most of them is fish farming. The average number of household labour involved in mitten crab farming is 2, working 8 hours/day. Casual labour works for 8 hours and is paid about CNY 110.00/day while permanent labour is paid an average of CNY 3,500.00/month. Most farmers have 6-10 years' farming experience; majority are involved in polyculture with shrimp as the major species mix with mitten crab. A greater number of farmers depends on their own savings for farming and operate between1-10 ha. Most farms are not insured against risks and disasters. A large number of farmers benefit from various training to enhance their capacities. It is therefore essential that authorities consider the socio-economic characteristics of mitten crab farmers for policy drive to help develop programmes and projects for successful implementation.

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Keywords: Profiling; Chinese mitten crab; farmers; Jiangsu province; China.

1. INTRODUCTION

Socio-economic characteristics are relevant in providing visions about rural realities, household heterogeneity and diverse livelihood approaches. These characteristics contribute towards designing of more realistic people-centerd rural development programs with high returns in terms of program or project sustainability [1]. A very limited study has been undertaken in this area for Chinese mitten crab. A careful study of socio-economic conditions of, e.g. Chinese mitten crab farmers is essential for the suitable design and successful implementation of governments' developmental programs. The socio-economic characteristics of fish farmers should be taken into consideration for the formulation, designing and successful implementation of developmental programs [2].

Socio-economic characteristics in relation to demography (e.g. family size, an age of farmer, education, experience, size and nature of ownership of pond), means of production and investment, income and expenditure pattern of people in various locations strongly influence their responses to technological changes and participation in development programs. Nonetheless, lack of reliable information on the socio-economic conditions of the target group and regular update of information is one of the severe impediments in the successful implementation of the developmental schemes. Some studies have been undertaken at different levels on socio-economic surveys by various researchers in the fisheries sector [3,2,4].

[5] undertook a study on identifying socio-economic features of fish farmers and stated in their concluding remarks that majority of fish farmers are in middle age group, education is up to middle level, and fish farmers have medium family size with sufficient experience in aquaculture. They have a medium level of social participation, smaller pond size with single ownership and low level of family income. According to [6], ages of mitten crab farmers around Hongze Lake fall between 27 years to 77 years. Majority of them have attained the basic level of education and built their experiences of crab farming from interaction with other mitten crab farmers. They employed family and hired labour in the crab farm activities. This study seeks to profile the farmers involved in Chinese mitten crab farming in the Jiangsu province focusing on three counties selected from three cities. This will contribute to knowledge in the aforementioned sector upon which policies can be designed, programmes developed and developmental project implemented to target groups.

2. Methodology

2.1 Study Area

Jiangsu is the major province involved in mitten crab farming, producing about half of the total mitten crab produced by the country. Three counties (cities) namely Changshu (Suzhou), Jintan (Changzhou) and Xinghua (Taizhou) within Jiangsu province were sampled for the study.

Mitten crab (*Eriocheir sinensis*) farming is a significant industry in Jiangsu province. The Jiangsu Bureau of Marine and Fisheries reported that crab production area in 2014 was 246,790 ha with production picking at 370,000 tons valued at CYN 28 billion representing 5.8% of the total fishery production and 19% of fishery production value in the province [7].

It is located in the central part of the eastern coastal area of China. It is an essential part of the Yangtze River Delta, including the Yangtze River, the lower Huaihe River, the Yellow Sea in the east, Shandong in the north, and Anhui in the west, Shanghai and Zhejiang in the southeast (116°18′-121°57′east latitude and 30°45°20 north latitude). The Yangtze River is the most reliable water resource located in the south of Jiangsu Province.

The eastern coastal fishing ground covers an area of 100,000 km^2, including the famous four fishing grounds, such as Lv Si, Haizhou Bay, Yangtze River Estuary and Dasha, which are rich in yellow croaker, hairtail and Pomfret, shrimps, crabs and shellfish and other aquatic products. The inland water surface has more than about 173 million hectares, and the breeding area is about 0.76 million hectares. There are more than 140 species of freshwater fishes, which are the main producing areas of Chinese crab and eel seedlings. The annual rainfall runoff in Jiangsu is between 150-400 mm. The plain areas of the Province are widely distributed in the deep Quaternary loose deposits and abundant groundwater resources [8].

Fig. 1

Sampling: A total of 120 questionnaires were deployed for the interview of Chinese mitten crab farmers out of which 80% were recovered.

Instrument: a Semi-structured questionnaire was developed for the soliciting of information from the mitten crab farmers in the study areas. The questionnaire was developed in Chinese language and translated into English after data had been collected. It was categorised into sections such as general information about crab farmer, production, costs, diseases and natural disasters as well as information on the marketing of crab out of which this paper was developed.

Data collection: The survey started with the review of relevant documents, reports, published papers, journals, and various books among others. Other documents were accessed from the internet and the Nanjing Agricultural University website.

Questionnaire administration: A cross-sectional data was employed in the questionnaire administration. A cross-sectional data set consist of a sample of individuals, households, firms, cities, states, countries, or a variety of units, taken at a given point in time. Sometimes, the data on all units do not correspond to precisely the same time period [9]. The target group was randomly selected at the counties. They were identified with the help of the technical officers (government officials working with Ministry of Agriculture) in these counties. The technical officers facilitated the data collection. The survey was conducted between August to December, 2017.

Data Analysis: Data collected was entered, stored and cleaned in excel. It was then exported into a statistical package for social sciences (SPSS version 25) for analysis. Descriptive statistics were employed in the analysis of the socio-economic data. The outputs generated were presented in the form of tables, frequencies, percentages, minimum, maximum, mean, standard deviations, charts and graphs. The descriptive analysis gives a simple and commonly understandable outline of the data [10].

3. RESULTS

3.1 Gender of Respondent

Table 1 summarizes gender of crab farmers in the sampled areas. The results depicts that most of the farmers interviewed are males (96.9%).

Table 1. Gender of interviewed crab farmers

Variable	Frequency	Percentage
Female	3	3.1
Male	93	96.9
Total	**96**	**100.0**

3.2 Age of respondents

Age of farmers gives knowledge about the category of participants involved in mitten crab farming. The ages range from 28 years to 72 years with an average age of 53 years and standard deviation of 9 years. Table 2 shows the ranges of the ages of the farmers. Most of the crab farmers (44.8%) fall between the ages of 46-55 years followed by about 32.3% who fall between the ages of 56-65 years. The least of respondents are between the ages of 26-35 years (3.1%) and 66-75 years (5.2%) respectively. From the results of the study, a greater percentage of the respondents lie between the ages of 36-65 years representing 74% (Table 2). This shows most farmers interviewed are within the active labour force.

Table 2. Age of crab farmers

Age	Frequency	Percent
26-35	3	3.1
36-45	14	14.6
46-55	43	44.8
56-65	31	32.3
66-75	5	5.2
Total	96	100.0

3.3 Educational Level

Table 3 depicts the educational level of the respondents. Educational level is a relevant indicator of socioeconomic variable that has some level of relationship with the understanding and adoption of technologies by mitten crab farmers Outcome from the result suggest that a greater percentage of the crab farmers (52.1%) have attained middle school level followed by those who have attained higher /technical education level (22.9%). The study revealed that 67.7% of the sampled crab farmers have attained basic level education. Almost all of the farmers are educated and can access information, adopt new technologies and undertake mitten crab farming activities.

3.4 Occupation

The studies point out that 61.5% of the respondents undertook crab farming as their primary occupation while the rest were involved in extension activities, pharmacist and in the public service (government workers) among others. There are 13.3% of the respondents who responded to the fact that they are involved in the secondary occupation. These include crab farming, trading, extension activities, pharmacist, and woodworking.

3.5 Household Size and Household Labour

Table 4 shows the summary of the household size of crab farmers. Analysis of the data suggests that household size range from 1 to 7 people with an average size of about 4 people. The modal household size is 3 people representing 30.2% followed by 5 people which represented 28.1%.

The number of household labour involved in crab production is summarized in Table 5. The results revealed that the minimum number of household labour force involved in mitten crab farming is 1 and maximum is 6 people with a mean of 2 and standard deviation of 1. The modal figure of household labour force involved in crab farming is 2 people representing 42.7% followed by 1 which represents about 32.3%.

In all, 75% of the crab farmers have a maximum of 2 household members involved in mitten crab farmers. This two (2) people could be the owner with the spouse. Results showed that the household labour force worked from 3 to 15 hrs/day with an average working time of 8 hrs per day and standard deviation of 3 hrs.

Table 3. Educational level of crab farmers

Education	Frequency	Percent
High school/technical secondary school	22	22.9
Junior college/bachelor degree	8	8.3
middle School	50	52.1
Primary	15	15.6
No School	1	1.0
Total	96	100.0

Table 4. Household size of crab farmers

Size of household	Frequency	Percent
1	3	3.1
2	14	14.6
3	29	30.2
4	19	19.8
5	27	28.1
6	3	3.1
7	1	1.0
Total	96	100.0

Table 5. Number of household labour in crab production

Number of household labour	Frequency	Percent
1	31	32.3
2	41	42.7
3	12	12.5
4	2	2.1
6	2	2.1
No response	8	8.3
Total	96	100.0

3.6 Experience of Crab Farmers

It is well established in studies that there is a significant relationship between experience and aquaculture activities.

Table 6. Experience of farmer (years) in crab production (2016)

Experience range	Frequency	Percent
1-5	13	13.5
6-10	25	26.0
11-15	20	20.8
16-20	24	25.0
21-25	5	5.2
26-30	7	7..3
31-35	2	2.1
Total	96	100.0

The experiences of the mitten crab farmers range from 2 to 35 years with an average of about 14 years and standard deviation of 8 years. Majority of the crab farmers sampled (26.0%) have been farming for a period of 6 to 10 years while 25.0% have been operating from 16 to 20 years (Table 6). Most of the farmers (69%) have experience ranging from 6 to 20 years in mitten crab farming.

3.7 Farming Type

The study shows that most of the crab farms (96.9%) are family operated with the least being that of cooperatives (3.1%). Those involved in cooperatives could be using assets (e.g. pond) of the cooperatives.

3.8 Type of Production

There are various production systems used in freshwater pond mitten crab farming. In terms of grow-out, a greater percentage of respondents sampled are into semi-intensive form of production (53.1%) followed by 46.9% who are into intensive crab production.

3.9 Mitten Crab Insurance

Mitten crab is regarded as a risky venture hence the need to safeguard production against risk and disasters. Outcome reveals that a little above half of the crab farmers (57.4%) had not insured their farms as against 42.6% who had. The implication is that most farms are prone to disasters and risk without an insurance cover hence may lose yield resulting in decline in revenue and for that matter household income.

3.10 Culture Type

Farmers either cropped the mitten crab alone (monoculture) (34.8%) or with other species (polyculture) (65.2%). Polyculture species include shrimps and fish species such as mandarin. Results revealed that polyculture of crab farming is common in the selected areas of study and shrimp is the major species cropped with mitten crab. Farmers sell the shrimp and other species such as mandarin for income to complement revenue from mitten crab sales. In addition, the mentioned species are also used as trash fish.

3.11 Pond Size Farmed

The pond size has relationship with productivity. Total size of pond employed by farmers in mitten crab farming ranges from 0.267 ha to 21.344 ha with an average of 3.268 ha and standard deviation of about 3.500 ha.

Table 7 summarizes the total pond size used by farmers by categorization. Results show that pond size less than 1 ha range from 0.27 ha to 0.93 ha with an average size of 0.67 ha and standard deviation of 0.208 ha for both years. Also, pond area between 1 to 10 ha for both years range between 1ha to 8.67 ha. Average farm size reported for both years are 3.11 ha About 76% of the crab farmers operate between 1 to 10 ha of pond size and 20% operates less than 1 ha.

Table 7. Summary of farm size (ha) category

Land size categorization		N	Min	Max	Mean	Std. dev
< 1	Pond size 2015	19	0.27	0.93	0.67	0.208
	Pond size 2016	19	0.27	0.93	0.67	0.208
1-10	Pond size 2015	73	1.00	8.67	3.11	2.160
	Pond size 2016	73	1.00	8.67	3.11	2.161
> 10	Pond size 2015	4	13.34	21.34	16.12	3.681
	Pond size 2016	4	6.67	20.01	14.12	5.602

i. Hired labour

- **Casual Labour**: Number of casual labour employed by mitten crab farmers range from 1 to 12 with average labour force of 5. The number of hours undertaken is between 2 to 10 hrs/ day with an average of about 8 hrs/day. Wages of casual labours range from CNY 50 to CNY 200/day with an average wage of CNY 110/day and standard deviation of CNY 52/day.
- **Permanent Labour**: Number of permanent labour employed in mitten crab farming ranges from 1 to 4 persons. Average number of permanent labour force for mitten crab production is 2 with standard deviation of 1. The labour force also worked from 2 months to 12 months in a year with average number of 8 month and standard deviation of 4 months in a year. Wages ranges from CNY 3000.00 to about CYN 4,000.00 per month.

3.12 Funding of Crab Farm by Farmers

The study shows that the sampled farmers' accessed funding for their crab farming activities from various sources such as own savings, relatives and friends, from the banks and also from cooperatives (Table 8). Most (72.9%) of the farmers depended on their own savings, 7.3% had some support from relatives and friends, 6.3% were assisted by the commercial banks while a few (2.1%) accessed funding from cooperatives and others.

3.13 Training

Training is a relevant component in fish farming. It is one of the means of transferring knowledge to farmers and fish farmers about new and enhanced technologies. Farmers were interviewed about their participation in training programmes related to aquaculture farming. In relation to capacity enhancement, majority of the respondents sampled have had some training before (94.8%) on aquaculture while the rest did not. Sources of training include promotion stations, enterprise/organizations, own studies, and consultation with fellow crab farmers. Most crab farmers (85.4%) depended on promotion/demonstration stations for training this may be as a result of many demonstration farms located in the study areas by the help of Ministry of Agriculture.

3.14 Farmers Future Plan

The future plan of most of the crab farmers (59.1%) is to maintain the size of their operations. Equal percentages are willing to expand their operations (20.4%) and also reduce it (20.4%). Those willing to expand their production intend to do so due to increase in demand for crab, improved technology, and profitability of the venture. Some mitten crab farmers will reduce their production due to lack of funding, limited/lack of labour, availability of off-spring seed and issues about diseases. There are those who will not change their production due to government policy such as quota on land use system, high rent cost and the fact that there is constant loss of water through seapage (loss of water).

Table 8. Sources of funding of crab farm

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
Individual (Own)	70	72.9%	26	27.1%	96	100.0%
Relatives/friends	7	7.3%	89	92.7%	96	100.0%
Bank	6	6.3%	90	93.8%	96	100.0%
Cooperatives/ others	2	2.1%	94	97.9%	96	100.0%

4. DISCUSSION

A greater percentage of Chinese mitten crab farmers interviewed are males. Fish farming and for that matter mitten crab farming in China is organized on family bases hence both spouses are equal in decision making in such an activity. Education is a major development enhancing tool and essential to people's chances in life [11]. It empowers people [12], in this case mitten crab farmers in China and improve their ability to communicate and make informed decisions. Results from the study suggest that almost all the mitten crab farmers are literate (99%), high percentage (30.9%) having benefited from higher education and more than half (67.7%) have attained basic level of education. Use of the educational level of farmers as a technical efficiency shifter is fairly a common thing in aquaculture [13]. Education may ensure access to information and capacity to comprehend the technical aspect related to mitten crab production as well as technical efficiency [14].

The ages of the mitten crab farmers' range from 28 years to 72 years. This falls within the years quoted by [6] on a study related to sustainable farming practices of the Chinese mitten crab. The study revealed that the age range of such farmers is between 27 and 77 years. Most mitten crab farmers sampled for this study fall within the ages of 46-55 years (45%) followed by those within the ages of 56-65 years (32.3%). Average age of the farmers was within the 50s (53 years). [14] were of the view that the older one is, the more experience the person/farmer becomes and likely to be more efficient in decisions regarding the use and allocation of scarce resources such as inputs.

Mitten crab farmers (62%) are involved in mitten crab production as their main occupation. The high percentage shows sustainability of the production in the industry. Others are involved in extension rendering activities, working at the pharmacy and public service (government institutions) among others. Secondary occupation also cut across diverse occupation such as mitten crab farming, trading, extension activities and pharmacist, and wood working.

Large family size according to [15] increases the tendency to adopt new technology. The average size of household is 4 with a maximum of 7 people and minimum of 1. Most household have 3 people. The number of household members involved in mitten crab farming ranges from 1 to 6 with an average of 2. Majority of the crab farmers have two persons involved in the farming. This could be made up of husband and wife. The family size of a Chinese is lower due to government "One-Child" policy which has been currently changed to 2. The time spent by household labour working on the farm ranges between 3 to 15 hours with an average of 8 hours. Number of casual labours employed also ranges from 1 to 12 persons. Average time spent is 8hrs/day. Also, average wage paid to a casual worker is reported to be CNY 110/day. The study further shows that the size of permanent labour force employed in the farm ranges from 1 to 4. Such people worked between 2 to 12 months in a year. Wages of permanent labour ranges from CNY 3,000.00 to CNY 4,000.00 per month. [6] reported a range of 1 to 6 as the range of permanent labour force in mitten crab farming.

Experience plays a vital role in aquaculture and fish farming as a whole. According to [2], experiences of aquaculture farmers have positive influence on fish production and that it should be taken into consideration when formulating aquaculture programs. Experiences of the sampled mitten crab farmers in this study ranges between 2 to 35 years with average of 14 years. Most crab farmers (72%) have been farming between 6 to 20 years. More experience expose farmers to more technology, farm management and ability to address challenges and issues affecting mitten crab farming. They forecast production and analyze marketing situation as well as take advantages of higher prices.

Most farmers interviewed are involved in family type of farming (having their own land) with very few into cooperative land ownership. Farmers are involved in intensive and semi-intensive system of farming with most into semi-intensive (53.1%) followed by intensive (46.9%) farming systems. Freshwater aquaculture in China almost always used models integrating principles of polyculture as a means of not only increasing productivity but also improving the use of feed resources, allochthonous and autochthonous, which then decreases nutrients in the effluent [16]. Result revealed that most mitten crab farmers are into polyculture (62.5%) farming and the rest are into monoculture. A good number mostly use shrimp to mix with crab. Some of the polyculture species is Mandarin fish species *(Siniperca chuasti)*.

In terms of funding of the mitten crab farming business, a good number of the farmers (72.9%)

depended entirely on their own resources while the rest also access from others sources such as friends, and relatives, commercial banks and cooperatives. The study shows some combinations of funding sources are accessed by a few of the farmers.

Pond size used by farmers' ranges between 0.27 ha and 21.34 ha with an average of 3.17 ha. Most of the farmers (76%) operated between 1 to 10 ha with about 20% operating less than 1 ha. It implies that a good number of the farmers fall outside small scale mitten crab farming by this categorization.

There are many definitions for insurance but one of them is "a service for the transfer to someone (insurer) of certain risks of financial loss in this case in mitten crab production in exchange of the payment of an agreed fixed amount" [17]. Fishery and aquaculture are considered as high risk sectors [18]. A little above half of the respondents (56.3%) interviewed had not insured their farms against any accident or risk which can result in the loss of property and crab output leading to decline in revenue. Results point to the fact that mitten crab farmers are not very much involved in insurance scheme for their farms. A study conducted by [7] indicated that fishery insurance system has been in existence for not less than 30 years in China. However, a large portion of the fishers have inadequate awareness of insurance schemes or lack the knowledge to effectively avail themselves to the schemes and that crab insurance was provided to farms of more than or equal to about 1.3ha in size. The studies therefore conclude that about 45% of the respondents who operate less than 1.401ha of area size of crab farm are automatically exempted from the insurance package for their crab farms in the Jiangsu province.

Farmers performance is directly linked to their human capital endowment, which encompasses both innate and learned skills [19]. From this study, a high percentage of crab farmers have benefited from various training programmes from the following source: promotion/demonstration stations, fellow farmers and have tutored themselves by reading from pamphlets, books and internet as well as from organizations and institutions. Most have received between 6-10 trainings in the year (64.6%) followed by 24.8% who have received between 1 to 5 trainings. A few (6.3%) had not received any training. Average number of training was 7. According to [20] and [21], the rationale for extension services, farmer education programs, and various forms of formal and informal training is the desire to enhance and expand farmers' human capital. Farmers also undertake initiatives to acquire knowledge from other sources (published media, radio), as well as from their own experiences and experimentation.

One of the future plans of most of the farmers (57.3%) is to maintain the size of their areas while the rest will either expand or reduce production. Farmers will increase production due to increase in demand, increase in profit and improvement in technology. Those who want to reduce intend to do so as a result of lack of funding, lack or limited labour force, limited seed availability and diseases attack on the crabs.

5. CONCLUSION

Summary of this study provides a socio-economic profile of mitten crab farmers in the selected areas of Jiangsu. The studies showed that most of the farmers interviewed are males. In fish farming including mitten crab farming in China, both spouses have equal decision making rights since farms are organized on family bases, Education play key role in aquaculture. Almost all sampled farmers (99%) interviewed are literate with 67.7% completing basic level. The higher percent of farmers with basic level of education calls for continues training to equip them with knowledge to better understand technical aspect of mitten crab production.

Farmers involved in mitten crab farming fall within the active labour force of 46 to 55 years (45%) encouraging sustainability of crab culture. Most of the respondents sampled (62%) engaged in mitten crab farming as their main occupation hence putting more effort in its culturing. Farmers depend on household labour on the farm with family labour supporting mitten crab farming ranges from 1 to 6 with an average of 2, working at about 8 hours a day. The two are presumed to be the husband and the spouse. Household labour is complemented by hired labour such as casual and permanent. Casual labourers also work for an average of 8 hours and are paid about CNY 110.00 per day. Permanent labourers/staff also work for a period of 2 to 12 months on the farm and are paid CNY 3,000.00 to CNY 4,000.00 monthly.

A good number of the farmers (72%) have gained much experience by farming for a period of 6 to 20 years with an average of 14 years.

They are well exposed to lots of technology, farm management including production. A little more than half of the farmers sampled (53.1%) are into semi-intensive farming, and most farmers favour polyculture with shrimp as the primary additional species. They depend on it to complement their income and also provide as trash fish for feeding the mitten crab. Access to credit is less among the mitten crab farmers as most farmers depend on own source of income. Most farmers (76%) can be classified as not being small-scale farmers as they operate between 1 to 10ha of pond size. Even though crab farming is a high-risk venture, results from the study suggest that about half (56.3%) of the farms not insured probably due to the fact that they fall below the required pond size (1.4 ha) to benefit from the government and provincial mitten crab insurance packages. Government at all levels with the insurance institutions in China can revisit the policy to help envelope such farmers.

Most farmers have received technical training. The sources of training are promotion/demonstration stations, organisations and institutions (including research institutions). Also, farmers learn from their fellow farmers, pamphlets, books, leaflets as well as from the internet. About a fourth of the farmers intend to expand the size of the areas farmed. Taken into consideration China's land policy and high rent, it is advisable they expand their productivity by adopting improved technology such as using highly developed genetic resources to increase yield. Farmers faced with lack of funding, limited labour force, access to seed and impact of diseases outbreak should join and seek advice and assistance from cooperatives as well as extension officers. They can also take advantage of government interventions.

From the above results, it is evident that government all over the world should consider the socio-economic aspect of fish farmers and for that matter mitten crab farmers to help develop and implement policies targeting the beneficiaries of the sector.

CONSENT

As per international standard or university standard written partcipants' consent has been collected and preserved by the authors.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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