PRINT: ISSN 0973-5070 ONLINE: ISSN 2456-6772
Ethno Med, 13(1): 37-43 (2019)
DOI: 10.31901/24566772.2019/13.1.581

Sustainable Agricultural Practices and Occupational Hazards with Respect to Farmer Health and Safety: A Pilot Study

D. Krishnaveni[1], R. Swamynathan[2] and A. Mansurali[3]

PSG Institute of Management, PSG College of Technology, Coimbatore 641 004, Tamil Nadu, India
Phone: [1]<+91 99400 40246>, [2]<+91 93600 22100>
E-mail: [1]<krishnaveni.damodaran@gmail.com>, [2]<swaminathan@psgim.ac.in>, [2]<swamynathan1@gmail.com>, [3]< mansurali@psgim.ac.in>

KEYWORDS Biological Hazards. Chemical Hazards. Mechanical Hazards. Physical Hazards. Sustainability. Traditional Medicine

ABSTRACT Despite having a huge segment of the country's population engaged in agriculture, farmer health and safety is under researched in India. The sector is unorganised and characterised by multitasking workers with low levels of education and technological exposure. Farmers are subjected to physical, mechanical, biological and chemical hazards in the course of everyday work. However, now a gradual awareness of sustainable practices is making inroads into the sector. This study evaluated the health and safety scores of farmers involved in conventional *vs.* sustainable farming styles and also analysed the impact of adoption of sustainable agricultural practices on the exposure levels to different occupational hazards. The results established that quality of health improved on following sustainable practices. As allopathic treatment is not always within physical or financial reach of farmers, this paper also documents the traditional remedies followed in combating symptoms of various health effects that arise because of farm employment.

INTRODUCTION

Agriculture is one of the largest employers of the Indian workforce and a significant contributor to the country's socio-economic status. Yet, despite its importance and its existence for thousands of years, very few steps have been taken to study or regulate the health and safety aspects of those involved in the process of farming in India.

In several regions of the country, farming is still carried on by small scale farmers, casual labourers or migrants who are not aware of the long term adverse consequences of following unsafe and sometimes perilous farming practices. Women and children family members often help out in the farms which frequently do not have even basic sanitary amenities or access to clean drinking water. The unorganised nature of the sector is compounded by the fact that most of the farmers are in the small or marginal bracket, are not highly educated and have low income levels.

On the other hand, agriculture itself is undergoing a metamorphosis with farmers increasingly becoming aware of the concept of sustainability of their practices and business. Sustainable agriculture not only has underlying goals relating to ethics, multi-functionality, stability, resilience and safety, but also includes environmental and social goals connected to human and animal health and well-being (Velten et al. 2015). Gradually farmers are leaning towards a reduced dependence on chemicals for production of their crops and livestock. The emphasis is on efficiently using nature to optimise production and decreasing human interference in the process (Dabholkar 2011). With a change in attitude, and implementation of sustainable practices, exposure levels of agricultural workers to different occupational health and safety hazards in farming are also changing.

Examining the impact of following sustainable practices on health and safety would aid

Address for correspondence:
D. Krishnaveni
Research Scholar
PSG Institute of Management,
PSG College of Technology,
Coimbatore 641 004,
Tamil Nadu, India
Phone: (+91) 99400 40246
E-mail: krishnaveni.damodaran@gmail.com

farmers in making the decision to transition to sustainable farming. For those farmers already engaged in sustainable farming, the study would help in evaluating their current health and safety situation and work on improvements. For policy makers and field advisors, the study emphasises the hazards in farm employment and highlights the areas needing precautionary training, awareness exercises and scope for insurance planning (Ponisio and Kremen 2016).

Review of Literature

Health, as defined by the World Health Organisation implies physical, mental and social wellness and not simply the lack of disease of infirmity (World Health Organisation 1948). Occupational health and safety refers to the risk of injury and/or illness connected with employment and is primarily concerned with the avoidance of workplace hazards.

Workers involved in agriculture have high exposure to different occupational hazards and account for a large number of workplace accidents every year. The International labour Organisation has identified several frequent agricultural hazards as shown in Figure 1 (Safe Work 2000).

Very broadly these hazards may be classified as being biological, chemical, physical or mechanical. Biological hazards refer to the threats posed by organisms or biological processes. Chemical hazards are characterised by their inherent properties which may harm human health. Physical hazards include natural events that have the potential to create great damage. Mechanical hazards are those that are caused by or involve a machine.

Most Indian farms offer a work environment where the workers are exposed to environmental elements such as weather changes, temperature variations, heat, rain, poisonous animals and plants. Most workers perform a variety of functions that involve sitting, standing or bending in unnatural positions sometimes for prolonged periods of time. Spraying of chemical pesticides or fertilisers is not always done with recommended protective gear. Workers may often need to work for hours in isolation from others. Awareness levels of the long term and short term impacts of agricultural work hazards is limited, and

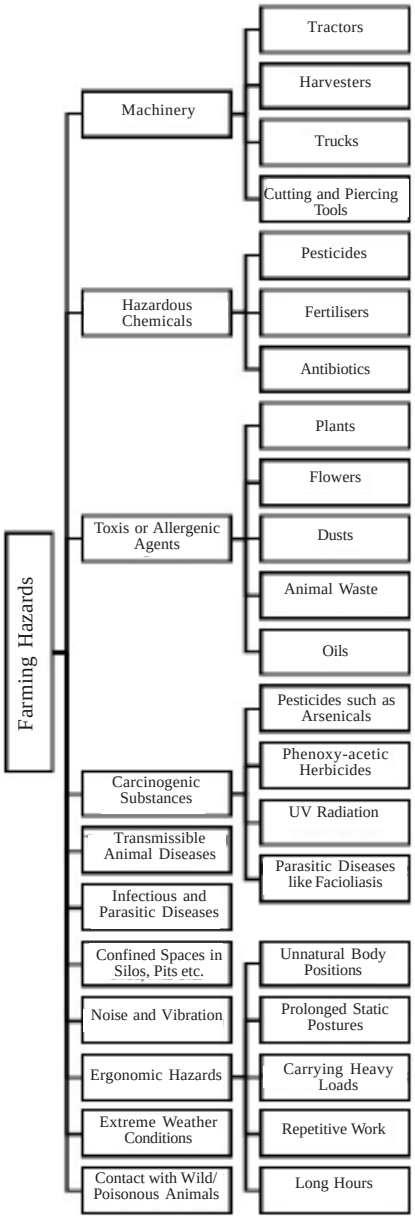

Fig. 1. Hazards in agriculture
Source: Author

rarely are health and safety allowances made on the basis of age, gender or physical ability.

A study on women farmers listed allergies, skin irritation, swollen/sore feet and hands, body

pain, tiredness, cuts/wounds, poisoning, breathing problems and eye irritation as some of the adverse effects of being involved in agriculture. Age and education levels showed a correlation with the incidence of health effects (Badodiya et al. 2013). Pesticide exposure has been known to cause cough, running nose, sore throat and other respiratory issues. Symptoms of pesticide exposure include excessive sweating, vomiting, itching, dizziness pain, headache, skin redness and excessive salivation (Reddy et al. 2016). Livestock workers are at a higher risk of machinery related accidents and ergonomic hazards (Qaisrani et al. 2018). Injury risk from livestock increased when animals were participating in high stress activities such as hoof trimming resulting in job strain for the handlers (Lindahl et al. 2015).

A review over a period of 25 years suggested that while multiple chemical exposure events led to higher instances of respiratory diseases and cancer, numerous physical hazard exposure events could result in hearing loss. Simultaneous and frequent exposure to physical, biological and mechanical hazards raised the risk of musculoskeletal disorders (Nguyen et al. 2018). Lack of awareness of the importance of protective equipment while farming, lack of necessary training and inconvenience of working with protective gear on, were some of the reasons for not taking adequate precautionary measures while farming (Oduwaiye et al. 2015).

Recent studies have been focussing on the effect of climatic hazards on farm workers. Climatic changes such as droughts, floods, tidal surges, erratic rainfall patterns and salinity intrusions have forced farmers to adapt their practices, sometimes even leading to change in crops and cropping patterns (Rahman et al. 2015; Hussain et al. 2018).

Organic farming is suggested as an alternative to conventional farming to mitigate or reduce the incidence of health hazards (Anjum et al. 2016; Ashraf et al. 2016). Other alternatives include Natural Farming as promoted by Fukuoka, Natueco Farming as promoted by S. A. Dabholkar and Korean Natural Farming as promoted by Cho Han Kyu. These methods remove or substantially reduce dependence on synthetically produced chemicals thereby reducing chemical hazard exposure. Also, in the case of Natural Farming as proposed by Fukuoka and Dabholkar, mechanical hazards are significantly reduced as human intervention is not encouraged. Lower use of external inputs and chemicals increases sustainability of the farming operations acting as an incentive to shift from conventional farming.

During the decade between 2002 and 2012, a study on Indian farmer borrowings and earnings indicated that the percentage of loans used for medical expenses doubled implying declining health levels (Satyasai 2015). Culturally in India, family members, relatives and friends influence medical decisions to a great extent (Khadir et al. 2016). However, with low access to modern medical amenities in many areas, farmers often fall back on traditional medication. Traditional medicine is practiced to offset symptoms of health hazards and illnesses among both farmers and livestock (Mafimisebi and Oguntade 2010; Panda et al. 2017).

The literature leads to the model shown in Figure 2 with respect to farmer health and safety:

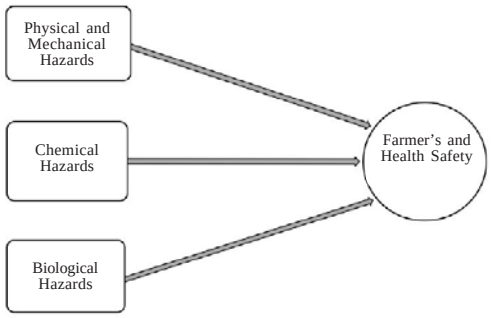

Fig. 2. Model depicting factors affecting farmer health and safety
Source: Author

Objectives

The objectives of the study are to:

1. Assess the difference in farmer health and safety levels between sustainable and conventional farmers.
2. Evaluate the differences in exposure to physical, mechanical, biological and chemical hazard levels between sustainable and conventional farmers.
3. Analyse the association between sustainable agricultural practices on farmer health and safety.

4. Compile traditional remedies resorted to by farmers to treat health issues arising from farm work.

The study is significant as investigating the difference in hazard exposure levels for sustainable and conventional farming styles will be important in aiding farmers in their decision to transition to sustainable practices. Agriculture Officers may also use the results of the study to advice farmers on precautions and correctness of procedures.

METHODOLOGY

The study is empirical in nature and uses primary data. A survey design was used as it best suited the purpose of the study.

Coimbatore district in the southern state of Tamil Nadu is naturally diverse and is situated in the rain shadow region of the Western Ghats. It is divided into 13 District Blocks for administrative purposes. Among the blocks which receive very low mean annual rainfall of less than 600 mm are Sulur, Sultanpet and Annur (Rathod and Aruchamy 2010). With few water resources, these blocks have the highest incentive to become sustainable in their practices. Therefore, the sampling frame included farmers from the blocks of Sulur, Sultanpet and Annur. The farmer lists were supplied by the Office of the Assistant Director of Agriculture in Coimbatore. The respondent farmers were selected using simple random sampling.

A questionnaire was developed to evaluate the adoption of sustainable agri practices, exposure levels to physical, mechanical, biological and chemical hazards, farmer health indicators and traditional remedies as shown in Figure 3. The questionnaire was administered on a pilot basis in the selected blocks and 51 responses were used for analysis.

RESULTS AND DISCUSSION

Of the 51 respondents, 42 were males of which 10 followed organic farming practices. The remaining followed conventional chemical based farming. Of the males, 12 were above the age of 50, 29 were between 30 and 50 years of age and 1 was below 30. Of the 9 females, 3 were above 50 and 6 were between 30 and 50 years of age as depicted in Table 1.

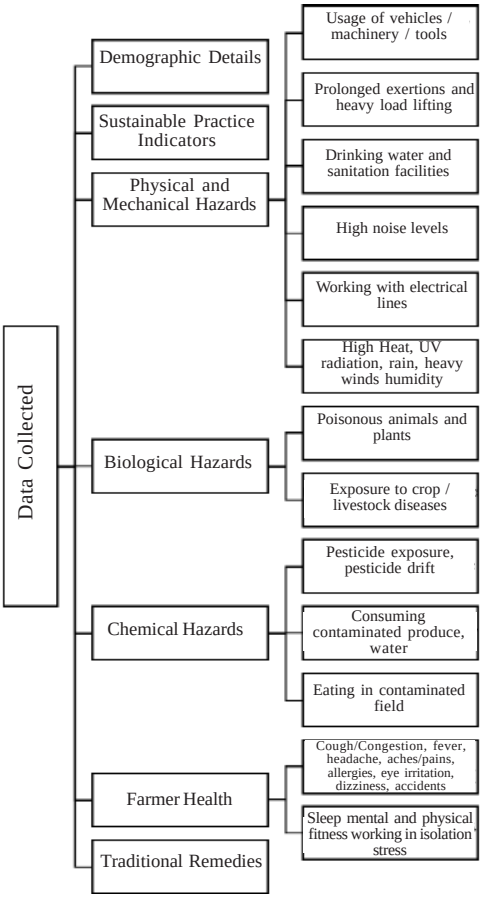

Fig. 3. Data sections in questionnaire
Source: Author

Table 1: Demographic details

	Male	*Female*
Total	42	9
Organic Practices	10	0
Age		
<30	1	0
30-50	29	6
>50	12	3

The means of the composite scores for Physical and Mechanical Hazards, Biological Hazards, Chemical Hazards and the overall Health and Safety Scores were compared for sustainable and conventional farmers using t-tests and the results presented in Table 2.

Table 2: t-test values

	Categories	*Mean*	*Standard deviation*	*Sig.*	*Inference*
Physical and Mechanical Hazards Score	Sustainable farmers	55.70	4.81	0.106	No significant difference in mean scores
	Conventional farmers	52.93	4.77		
Biological Hazards Score	Sustainable Farmers	15.50	1.65	0.063	No significant difference in mean scores
	Conventional farmers	17.15	2.60		
Chemical Hazards Score	Sustainable Farmers	8.50	1.58	0.000	Significant difference in mean scores
	Conventional farmers	17.24	2.71		
Health and Safety Score	Sustainable Farmers	79.80	6.83	0.000	Significant difference in mean scores
	Conventional farmers	63.41	6.55		

The Physical and Mechanical Hazard Scores and the Biological Hazard Scores did not show any significant difference in means indicating that physical labour, climatic and other environmental conditions and exposure to biological threats like venomous animals and poisonous plants were similar in both farming styles. In the case of Chemical Hazard Scores, a significant difference in the means was observed due to the application of synthetic chemical fertilisers, pesticides and antibiotics that resulted in increased risk of chemical spills, drift and ill effects due to eating in a contaminated field or consumption of contaminated crops or water. Similarly, Health and Safety Scores showed a significant difference in mean values primarily due to higher incidence of cough, congestion, headaches, allergic reactions, eye irritation and dizziness among conventional farmers. Occurrence of muscle pain, vehicular accidents, accidents with tools and sleeping hours did not show significant variation among both groups.

In order to evaluate the strength and direction of the relationship between the adoption of sustainable practices (Sustainability Practice Score) and the Health and Safety Score, a test of correlation showed a statistically significant linear relationship between the two with $p<0.001$ and $r = 0.829$. While this does not imply causation, it highlights a degree of association between Sustainable Practices and Health and Safety.

To examine the nature of relationship between Health and Safety Score and Sustainability Practice Score, a regression test was performed with the former as the dependent variable and latter as the independent variable. The test presented an R^2 value of 0.687 as shown in Table 3.

Table 4 shows that as $p<0.05$, the regression model significantly predicts the dependent variable leading to the following equation:

Health and Safety Score = $53.739 + 0.225^{*}$ (Sustainability Practice Score)

About 31.3 percent of the variations are not explained by the regression coefficient account-

Table 3: R square value

Model	*R*	*R square*	*Adjusted R square*	*Standard error of the estimate*
1	0.829	0.687	0.681	5.234

Table 4: Regression

Model	*Unstandardized coefficients*		*Standardised coefficients*	*T*	*Sig.*
	B	*Std. Error*	*Beta*		
Constant	53.739	1.442	0.829	37.268	.000
Sustainability Practice Score	0.225	0.022		10.379	.000

Table 5: Traditional remedies for farmer ailments

Illness/Injury	*Remedy*
Cough	A decoction of long pepper, dry ginger and black pepper boiled in water and mixed with honey
Fever	Nilavembu kashayam (Andrographis paniculata decoction)
	Decoction made by boiling in mud pot upto one-third of original volume - long pepper, licorice, fine leaf fumitory, nutmeg, nut galls, yellow fruit night-shade, clove, cumin seeds, black pepper, lesser galangal, neem bark powder, curry leaf stem, banana bunch stalk, holy basil, Indian Borage, betel leaf stalk, black cumin seeds - to be had at morning and night for three days
	Boiling papaya leaves in water and drinking - to increase immunity
Headache	Cut eucalyptus leaf and keep pieces on forehead
	Boiling Chinese chaste tree leaves in water and breathing in the vapour
	Betel leaf cut into pieces and pressed on forehead
Muscle pain	Hot water bath
	Hot water bath with eucalyptus leaves in bath water
Allergic reaction	Apply coconut oil / turmeric
Eye irritation	Castor oil drops in eyes
	2-3 drops of human breast milk in eye
Dizziness	Dry ginger coffee
	A few drops of essence of lime and ginger mixed in honey consumed on an empty stomach
Hearing	A few drops of gingelly oil heated slightly and poured into the ear
	Fry nut-leaved screw tree nut in oil and on cooling, add a few drops of filtered oil in ear
Cuts/Wounds	Apply calcium (sunnambu) on wound
	Apply mud / ash (sambal) / turmeric on small wounds

ing for factors such as genetic endowments, demographic factors such as age and gender and personal health habits. However, through adoption of sustainable practices such as planting seeds in season, practicing multi and inter cropping, crop rotation, mulching, planting cover crops, minimum tilling, natural fertilisers and pesticides, usage of pest distractors, preventing dirty water/run-off from entering the field, planning irrigation schedules on the basis of the crop and predicted rainfall, usage of farm waste and adequate training and knowledge upgradation, farmers can ensure a higher health and safety score.

The results have shown that adopting sustainable practices is beneficial for the health of farmers. On the hierarchy of hazard controls, the lowest level is that of using Personal Protective Equipment which is necessary in conventional agriculture. Unfortunately, many farmers are unaware or unable to afford protective gear or unconcerned about the long term medical effects. This reinforces some of the results as observed in a recent study in Ethiopia where only about ten percent of the farmers studied used personal protective equipment (Negatu et al. 2016). Being trapped in debt cycles, they are more intent on increasing productivity of their lands than on investing in their health.

In contrast, by virtue of not using synthetic chemicals, sustainable agriculture is on the highest level of Elimination in the hierarchy of hazard controls where the hazard is done away with. However, with similar, physical, mechanical and biological hazard exposure levels, fundamental changes need to brought into the way farming is practiced to safeguard farmers. More awareness on the use of chemicals and of taking advantages of natural cycles and processes are required so farm workers can capitalise on synergies and move away from linear production.

Farmer health is not usually high on the list of farmers' priorities in the Coimbatore district. Accidents, symptoms of ill health, snake bites, exposure to poisonous plants and so on are considered normal occurrences and overt precautions are rare. A study in New Zealand supports the fact that risk acceptance and tolerance is relatively high among agricultural workers (Brown 2015). As allopathic medicine is not always conveniently accessible, farmers resort to traditional medicine to combat the various health effects of farming as shown in Table 5.

CONCLUSION

The study helped to evaluate the sustainable agricultural practices followed by farmers in the low rainfall areas of Coimbatore district. Analysing the impact of these practices on the health and safety levels of farmers showed that

exposure to chemical hazards was significantly lower on following sustainable practices over conventional agriculture.

RECOMMENDATIONS

The lack of decrease in exposure to physical, mechanical and biological hazards shows that improvements need to be made in agricultural practices to protect farmers. Awareness and access to protective equipment and medicines is imperative.

LIMITATIONS

The study is limited by the fact that it is geographically confined to the low rainfall areas of Sulur, Annur and Sultanpet in the district of Coimbatore where the major crops are maize and coconut. As crops vary, the processes involved in their production and storage vary, therefore the hazard exposure levels would also be different. A deeper analysis is required to establish relationships between health and safety and sustainability scores using moderating variables such as age and education levels of farm workers. Psychosocial hazards that deal with psychological well-being of farmers has not been included in this study. Business related variables such as over or under production, middlemen, storage and transportation issues, shortage of labour and market price fluctuations are issues that may have a bearing on the mental well-being of the farmer and need to be factored into future studies.

Research on farmers' health in India is inadequate and more longitudinal studies are required to be able to establish causal effects. Research needs to particularly focus on women and children who are employed on farms to understand the impact of their work on their physical, biological and emotional well-being.

REFERENCES

Anjum AS, Zada R, Tareen WH 2016. Organic farming: Hope for the sustainable livelihoods of future generations in Pakistan. *Journal of Rural Development and Agriculture,* 1(1): 20-29.

Ashraf I, Ahmad I, Nafees M et al. 2016. A review on organic farming for sustainable agricultural production. *Pure and Applied Biology,* 5(2): 277-286.

Badodiya SK, Tiwari A, Daipuria OP 2013. Health hazards among tribal farm women in agricultural operations. *Indian Research Journal of Extension Education,* 13(3): 47-51.

Brown C 2015. *Changing Perceptions of Health and Safety in Agriculture: Current Farmer Attitudes and Frameworks for Changing the Culture.* New Zealand: Kellogg Rural Leadership Programme.

Dabholkar S 2011. *Plenty for All.* Pune: Mehta Publishing House.

Hussain A, Rasul G, Mahapatra B et al. 2018. Climate change-induced hazards and local adaptations in agriculture: A study from Koshi River Basin, Nepal. *Natural Hazards,* 91(3): 1365-1383.

Khadir F, Swamynathan R, Mansurali A 2016. Antecedents of inpatient complaining behavior. *Studies on Ethno-Medicine,* 10(3): 325-335.

Lindahl C, Pinzke S, Keeling LJ et al. 2015. The effect of stress, attitudes and behavior on safety during animal handling in Swedish dairy farming. *Journal of Agricultural Safety and Health,* 21(1): 13-34.

Mafimisebi TE, Oguntade AE 2010. Preparation and use of plant medicines for farmers' health in Southwest Nigeria: Socio-cultural, magico-religious and economic aspects. *Journal of Ethnobiology and Ethnomedicine,* 6(1): 1-9.

Negatu B, Kromhout H, Mekonnen Y et al. 2016. Use of chemical pesticides in Ethiopia: A cross-sectional comparative study on knowledge, attitude and practice of farmers and farm workers in three farming systems. *The Annals of Occupational Hygiene,* 60(5): 551-566.

Nguyen T, Bertin M, Bodin J et al. 2018. Multiple exposures and co-exposures to occupational hazards among agricultural workers: A systematic review of observational studies. *Safety and Health at Work,* 9(3): 239-248.

Oduwaiye MO, Akangbe JA, Komolafe SE et al. 2015. An assessment of knowledge of farming-related hazards and precautionary practices of farmers in Kwara State, Nigeria. *Journal of Research in Forestry, Wildlife and Environment,* 7(2): 27-35.

Panda T, Mishra N, Pradhan BK et al. 2017. Plants used in traditional healthcare of livestock: A case study from Kendrapara district, Odisha, India. *Journal of Medicinal Plants Studies,* 5(4): 75-182.

Ponisio L, Kremen C 2016. System-level approach needed to evaluate the transition to more sustainable agriculture. *Proceedings of the Royal Society B,* 283: 1-3.

Qaisrani M, Baig N, Rathore T et al. 2018. Occupational health hazards of livestock workers in Pakistan. *Pakistan Journal of Public Health,* 8(1): 52-57.

Rahman MS, Abdul Ahad Biswas AKM, Rahman S et al. 2015. Climatic hazards and impacts on agricultural practices in southern part of Bangladesh. *Journal of Health and Environmental Research,* 1(1): 1-11.

Rathod I, Aruchamy S 2010. Spatial analysis of rainfall variation in Coimbatore District Tamilnadu using GIS. *International Journal of Geomatics and Geosciences,* 1(2): 106-118.

Reddy PN, Lakshmi T, Prasad SV 2016. Strategies to reduce health hazards of cotton farmers due to pesticides. *Advances in Life Sciences,* 5(5): 1848-1850.

Safe Work 2000. *Safety and Health in Agriculture*. Geneva: International Labour Office.

Satyasai K 2015. How Indian farmers borrow, produce and earn? *Rural Pulse,* 1(8): 1-4.

Velten S, Leventon J, Jager N et al. 2015. What is sustainable agriculture? A systematic review. *Sustainability,* 7: 7833-7865.

World Health Organisation 1948. *Constitution of the World Health Organisation.* Geneva: World Health Organisation.

Paper received for publication on November 2018
Paper accepted for publication on January 2019