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JOS has been founded on the spirit of participation. We have identified a need, worked with stakeholders to ensure that it meets all needs and pursued it till a point of completion. Our work has been voluntary and collaborative. We have much more to do and require your support.

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EDITORIAL: THE RECURRING ISSUE OF RESEARCH IN ORGANIC AGRICULTURE

Dr Els Wynen (els.wynen@elspl.com.au), Founding Director, *Journal of Organic Systems*
27 October, 2011

A previous JOS editorial (Vol 6(1)) pointed out the positive and negative realities of developments in organic agriculture in our region. In the subsequent editorial (Vol 6(2)), one way forward was seen as development in leadership. And what about a focus on research and development?

Public funding for research and development (R&D) in organic agriculture has been very limited in Australia and New Zealand[1] in the past. Public investment has been around $250,000 per year over the last 13 years via the Rural Industries Research and Development Corporation (RIRDC; Kristiansen 2011), the single largest source of funding for R&D in organic agriculture in Australia. The investment is very small in comparison with agriculture in general in Australia and with investments in organic agriculture in many other countries. In NZ the investment has been somewhat higher - NZ$2.1 over the period 2006 to 2009, which was mainly for advisory services (Organics Aotearoa New Zealand 2009).

In a recent report, the Australian Productivity Commission (2011) mentions that approximately $490 million a year is invested in R&D by the rural industries and the government through the Rural Research and Development Corporations (RDCs). Money set aside for organic agriculture in RIRDC would therefore be well under 0.1% of the total investment via the RDCs in agriculture in Australia, considerably less than the percentage of land under organic management at 2.9% (Wynen *et al.* 2011) or the 1% of total market value of organic products mentioned by Mitchell *et al.* (2010).

There is no public or private organization in Australia that specializes in carrying out research in organic agriculture, such as the Swiss Research Institute of Organic Agriculture (FiBL), founded in 1973; the Louis Bolk Institute in The Netherlands established in 1976; the Organic Research Centre ‘Elm Farm’ and the Henry Doubleday Research Association (HDRA) established in the UK in 1980 and 1984, respectively; and the Norwegian Research Institute for Organic Agriculture (NORSOK) founded in 1987.

The USA has its Rodale Institute (since 1947), the Organic Farming Research Foundation (since 1990) and a number of other organisations. Recently, the US Department of Agriculture’s Economic Research Service has become directly involved in research into organic agriculture.

In Europe, there are two models of agricultural research. One is a virtual centre that receives money for research, especially from the government, and commissions experts in diverse institutions to do the actual work. This example seems to work well in Denmark. In Switzerland, the system is to gather all researchers in organic agriculture in one institute, the FIBL.

Anybody who visits FIBL can’t fail to be impressed about what happens there. Founded almost 40 years ago, it has now grown to an institute with approximately 90 full-time researchers, working in many different areas. Key areas of emphasis are as diverse as soil fertility (maintaining and raising); resisting pests and diseases (by promoting beneficial organisms, applying direct control measures, and improving cultivation techniques); quality of organic products and the processing involved. Veterinarians are engaged in research into udder health and parasites – optimising husbandry, feeding and pasture regimes and test homeopathic remedies and plant preparations. The socioeconomics division analyses business problems at organic farms, pricing of organic goods and cost recovery levels, agricultural support measures and marketing issues. Numerous projects and data collection programs are taking place on more than 200 working organic farms throughout Switzerland. In other words, there is no need for convincing anybody about the need for organic agriculture, or to educate the public how to shop. The emphasis is on how organic agriculture actually works and how to maximise its potential in production (e.g. soil and environment), processing, and the social and economic consequences of organic agriculture.

One could well ask: what does all this cost, and where does the money come from? In total, the Swiss government spends about AU$12 million on organic agriculture, of which about AU$5 million goes to FIBL, AU$5 million to state research stations, and AU$2 million to universities. FIBL itself works with a budget of well over AU$ 10 million per year.

[1] Thanks to Brendan Hoare for provision of information on the situation in New Zealand.

Just imagine, this kind of money, what would we spend it on? In Australia, the Trust for Environmental Research and Education ('Organic Trust', http://organictrust.ofa.org.au) was established in 2010, and sees as its priorities educating the consumer about what can be trusted in the shops as being genuinely organic; ways in which to manufacture and provide tailored compost to the farmer (also broadacre); and educating the general person on what organic agriculture does (minimize externalities such as pollution and carbon footprint). All this obviously is far removed from the level of research happening in Switzerland for example, but still very much worthwhile if demand is to be stimulated – a must for the growth in organic production.

At a more local level, the State Government of Victoria invested A$1.08 million from 2008 to 2011 to develop the organic industry in that state. Part of it was used for research and education, such as industry data collection to identify the value of the organic industry in Victoria; supply chain development; and conversion to organic. There are few other organizations investing in research in organic agriculture in Australia, but those that are, tend to focus on activities for which it is possible to recoup costs - such as the marketing report by the Biological Farmers of Australia (BFA), which provides data on the organic market in Australia (Mitchell *et al.* 2010).

In New Zealand, the situation has been somewhat more positive, as Organics Aotearoa New Zealand (OANZ) received NZ$2.1 for advisory services covering the period 2006 to 2009. But research funding in the public and private sectors has also been minimal. Out of the Biological Husbandry Unit (BHU), set up at Lincoln University by Bob Crowder in the 1980s, the BHU Organics Trust was formed in 2001 as a cooperation between Lincoln University and the NZ Organic Movement. In January 2011 there was a recommendation that the Trust create an agricultural/horticultural science and extension centre dedicated to permanent agri/horticultures such as organics, agro-ecology, biological farming, etc. This resulted in the very recently started BHU Future Farming Centre (FFC). No figures were mentioned for actual spending on research in organic farming.

Much has been said in the past about the reasons for the lack of R&D money in organic agriculture. Calculations have been made in Australia about contributions by organic farmers to obligatory research levies, comparing it with allocations of research funding directly to the organic sector (e.g. Wynen 2003) and finding it wanting. Perhaps the recent Report by the Productivity Commission (2011) provides some spark of hope for increased public funding for research into organic agriculture in the future. It recognizes that research into non-commodity specific areas (as organic agriculture is) is neglected under the current arrangements, and suggests that this should be address in future arrangements. Here is hoping for you.

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THE ADOPTION OF ORGANIC RICE FARMING IN NORTHEASTERN THAILAND

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Abstract

The economic and environmental justification for certified organic farming could be considered strong enough to promote its adoption in the developing countries. Due to the problems facing conventional farmers, and reported benefits and opportunities derived from organic farming, questions may be asked about why organic agriculture is not adopted by a larger proportion of farmers. Contract and non-contract organic rice farms in northeastern Thailand versus their neighbouring conventional farms were used for this study. Descriptive statistics were used to investigate both organic and conventional farms and duration analysis was applied to investigate the factors affecting the adoption and diffusion of organic farming. The results reveal that important factors on decision of adoption of organic farming that were positively significant included water accessibility, farm-gate price and attitude to conventional production problems. This implies that the early organic adopter may have better access to water, the ability to seek and find higher prices, and have stronger attitudes toward conventional farming problems. This research may help to improve policy interventions by targeting policies on farmers who are most likely to remain in the sector.

Key words: adoption, Cox model, organic farming, rice, Thailand.

Introduction

Organic agriculture is one of the most dynamic and rapidly-growing sectors of the global food industry (Ellis *et al*. 2006). Furthermore, organic farming is one of several approaches to sustainable agriculture (FAO 1999b), because of its commercial viability, and it may provide solutions to the current problems in conventional agriculture (Scialabba 2000; Wheeler 2008). Organic agriculture is frequently promoted as an exit strategy from poverty for small-scale marginal producers in developing countries (Cary and Wilkinson 1997). A great deal of the literature focuses on understanding factors that motivate farmers to adopt organic farming practices. Lampkin and Padel (1994) and Padel (1994) reviewed the evidence on the motivations of organic farmers, and identified the most common factors among organic producers as concerns about their family's health, concerns about husbandry (e.g., soil degradation, animal welfare), lifestyle choice (ideological, philosophical, religious) and financial considerations. Colman (1994) has argued that the motives for economic behaviour cannot be reduced simply to profit maximisation, rather they '…may be complex, of benefit to a third party, to serve political or religious cause or reflect other motives than satisfaction in personal consumption or ownership', several other important factors could also impact the adoption of organic farming, including economic conditions, management skills, agro-climatic conditions and social considerations (Marshall 1993). The importance of information and knowledge were emphasised in several studies that examined the process of converting into organic agriculture (Aker *et al*. 2005). Mahamud (2005) mentioned significant factors affecting the acceptance of organic rice production as level of organic agriculture knowledge and extension measures received from involved agencies. It is unclear whether similar factors influence adoption of organic farming in countries such as Thailand.

In Thailand, agriculture is the most important sector for sustaining growth and reducing poverty. Approximately 50% of the total population or 5.8 million households are engaged in agricultural sector (NSO 2008). Agriculture is both a major export income source and social welfare system. Thailand is the world's largest rice exporter; peopled by connoisseurs of rice varieties and quantity (Falvey 2000). Rice farming utilises half of the agricultural land (10.2 million hectares) of the country (OAE 2008). But rice is facing the problem of low profitability mainly because of the declining demand in both international and domestic markets (Ahmad and Isvilanonda 2003). At the same time, the impacts of excessive use of agro-chemicals are apparent, with increasingly frequent health incidents among farmers and consumers reported (FAO 2004a). In addition, most chemical fertilisers, pesticides, gasoline, etc. are not the domestic reliance but are imported inputs. More importantly, the price of modern inputs (mineral fertiliser and synthetic pesticides) increases each year, negatively affecting farmers' income (Tovignan and Nuppenau 2004). The dual cost price squeeze drove farmers to the edge of bankruptcy when prices of agricultural products declined sharply while production costs rose steadily. Millions of small-scale farmers were driven to indebtedness and forced out of their farmlands (Panyakul 2003).

Organic farming re-emerged in Thailand in the early 1980's after the health and environmental effects of improper use of and heavy reliance on agrochemicals began to manifest themselves. Current organic production is predominantly of rice, with vegetables as a distant second and baby corn standing out (USDA 2006; Ratanawaraha *et al*. 2007). Green Net and the Earth Net Foundation estimate that the area under organic farming in Thailand increased from just over 2,100 ha in 2001 to 21,701 hectares in 2005, representing 0.10 percent of the total agricultural land area (21million hectares) (Ellis *et al.* 2006). Moreover, Thailand's National Agenda on Organic Agriculture was launched in October 2005. The total budget for the Agenda is 1.2 billion baht (US$ 39 million) over four years (USDA 2006).

This study tries to determine the important influencing factors for adoption of organic rice farming in Thailand and to formulate recommendations for improving ways to extend organic farming in Thailand.

Methodology

Data for the study was collected in northeastern Thailand during crop year 2007/08. Surin and Yasothon provinces are situated in the area which is the best place for planting Jasmine rice in Thailand. The Surin and Yasothon Provinces are the main areas of organic rice cultivation and were therefore selected as the study areas. Contact and non-contract organic rice farms in Surin and Yasothon versus their neighbouring conventional farms were selected. In addition, other stakeholders in whole country were selected. Sampling method of the study is multi-stage method. The first stage of sampling is stratified sampling for 4 categories of stakeholder (organic farmers, conventional farmers, NGOs, government officials, processors and handlers). Later simple random sampling by using snowball technique was applied for 180 farmers overall survey with comprises of 90 organic rice farms and 90 conventional farms. Finally, purposive sampling of samples that are suitable key informants, 6 organic farms and 20 other stakeholders for interview.

Descriptive statistic analysis was applied to summarise the important characteristics of the rice samples by using simple statistic analysis, i.e. frequency, percentage, mean, mode.

Since time plays an important role in explaining farming decisions, a dynamic econometric framework (duration analysis) is used to model adoption of organic rice farming (Läpple 2009). In this approach the variable of interest is the length of time until a certain event occurs or until the measurement is taken (Greene 2003). An important feature of the approach is that one can estimate the probability that a farmer with given attributes will adopt organic practices in a particular year, given that adoption had not occurred by that time.

Since this research includes only organic farmers who are certified with an organic certification body on all or a part of the farm, the start date (t=0) is either 1995 when the first organic certification body began operating in Thailand, or the date when the farmer started farming as the main farm holder, whichever is latest. The end of the spell is either the date when the farmer adopted organic farming (started the conversion period), while for the conventional farmers, spells are right censored at the time of data collection.

In duration analysis the hazard function and the survivor function are the key concepts. Let T be a nonnegative continuous[1] random variable representing the length of a spell with a probability density function $f(t)$ and a cumulative distribution function $F(t)$ (Jenkins 2004). The survivor function $S(t)$ gives the probability that the spell is at least of length t, which means the probability of surviving beyond time t. The survivor function is given by:

$$S(t) = 1 - F(t) = \Pr(T > t) \tag{1}$$

The survivor function equals one at $t = 0$ and strictly decreases towards zero as t goes to infinity. This implies an underlying assumption that all observations will eventually end in an event. However, at the time of measurement, it is usual that not all spells are completed. Since the spell end dates for these observations are unknown, right censoring at the time t of data collection is necessary. The only thing that is known about a censored observation is that the completed spell is of length $T > t$.

The density function $f(t)$, which is the slope of the failure function $F(t)$, can also be obtained from $S(t)$:

$$f(t) = \frac{dF(t)}{dt} = \frac{d}{dt}\{1 - S(t)\} = -S'(t) \tag{2}$$

The hazard function $h(t)$ is the instantaneous rate of failure. It provides the probability that the event will end in the next short interval Δt , conditional upon survival to that time,

$$h(t) = \lim_{\Delta t \to 0} \frac{\Pr(t \le T \le t + \Delta t \mid T \ge t)}{\Delta t}) = \frac{f(t)}{S(t)} \quad (3)$$

A Cox proportional hazards model is chosen and estimated for the adoption decision. The Cox model is robust because the results from using the Cox model will closely approximate the results for the correct parametric model, reasonably good estimate of regression coefficients, hazard ratios of interest and adjusted survival curves can be obtained for a wide variety of data situation, even though the baseline hazard is not specified (Kleinbaum and Klien 2005).

In the proportional hazards model of Cox, independent failure times $T_1, T_2, ..., T_n$ are studied, with the distribution being described by a hazard function $h(t, X)$ given by Kalbfleish and Prentice (2002):

$$h(t, X) = h_0(t)\exp(\beta' X) \quad (4)$$

where $h_0(t)$ is an arbitrary unspecified base-line hazard function which specifies a continuous distribution for a failure rate and a second term $\exp(\beta' X)$ incorporating the influences of covariates on the hazard rate (Blossfeld *et al*. 2007).

Based on literature, the factors that motivated the conversion could be distinguished as economic and non-economic factors. The important factors that could impact on the adoption of organic farming include financial competitiveness, management skills, agro-climatic conditions and social considerations.

Duration analysis is applied to determine the factors affecting the adoption and diffusion of organic farming on all or part of the farm. The explanatory variables that hypothesised decision on the adoption of organic farming are grouped into four categories: household and farmer characteristics, production, economic, and psychology. The household and farmer characteristics comprised year of education (EDU), and land ownership (LTENURE) were hypothesised to have a positive influence, while liability (DEBT), and off-farm work (OFFW) were hypothesised to have a negative effect on adoption of organic farming. The production factors consisted of availability to access water during dry period (ACWATER), farm size (FSIZE), and household labour (LABOUR). The economic factor is farm-gate price (FGPRICE). The psychological factors are attitude towards problem from conventional technology (CPROBLEM), and supporting organic input credit special credit for organic farming (CREDIT). These were hypothesised to have a positive effect on adoption of organic farming. The factors affecting adoption of organic farming were analysed using binary logistic regression, and survival analysis in the STATA program.

Results and discussions

1. Household and farm characteristics

The evidence from the field survey indicates that the average size of the farm households is of medium size, which means that it consisted of 4 members. The farm labour force referred to those members of the households with labour force status who actually work on the household farm full-time or part-time basis in all round year. The results reveal statistically significant difference (at 10% level) in average farm family labour (ME) between conventional and organic samples (Table 1). This can be imply that organic rice farms require greater labour input in term of full-time labour than conventional farms.

The average total land size per family is approximately 17.58 rai, which is lower than the average of the country (22.56 rai) and of the northeastern region (21.23 rai) (OAE 2008). Moreover, this farm land is divided into two to three paddy plots or more. The average rice farm size is about 15.62 rai. The results show no statistically significant differences in total agricultural land and average rice farm size between organic and conventional farms. However, land is significant difference between contract and non-contract organic farms.

Most of jasmine rice farms are located in rain fed area; nevertheless, some farms are engaged in small irrigation project. The results show that more than 87 percent of conventional farms and 67 percent of organic samples are rain fed farms. In specific, 70 percent of contract organic farms are partial and irrigated farms with engaged in small irrigation project, while most of non-contract organic farms located in rainfed area and no accessibility on water during dry season.

The average production of organic samples is 5,932.39 kg per farm, meanwhile conventional farms have higher average production about 6,725.78 kg per farm. The average yield per rai of organic farms is slightly lower than conventional farms about 389.26 kg per rai versus 420.36 kg per rai (3.61 percent of difference). Globally, organic plant yields are on average 10% below conventional systems. Global averages do vary between extensive and intensive systems because the conventional comparator is different (MacRae *et al*. 2004). Therefore, improving scientific knowledge on organic farming is necessary.

The paddy price of organic rice is highly statistically significant than conventional farms at 10.71 THB per kg and 9.08 THB per kg, while no difference between prices of contract and non-contract organic paddy dues to rice price is rose in the crop year. But between non-contract organic, ACFS farms have significantly higher price than ACT farms (Table 1). Because many of them sell their paddy at cooperative mill and they get market price with return profit, while some farms sell paddy as seed, as the result they get higher price.

Table 1. Household and farm characteristics.

	All samples (n=180)	Conv. Samples (n=90)	Organic samples (n=90)				
			Total organic	Non-contract			Contract
				ACFS	ACT	Total	
Household size (persons)							
Mean	3.96	3.53	4.38	4.40	4.33	4.37	4.40
SD	1.58	1.54	1.52	1.73	1.42	1.57	1.43
t-value		3.707***		-0.163^{NS}		0.098^{NS}	
Farm family labour (ME)							
Mean	1.97	1.87	2.01	2.16	1.99	2.07	2.06
SD	0.69	0.68	0.68	0.78	0.76	0.77	0.47
t-value		1.915*		-0.851^{NS}		-0.119^{NS}	
Rice farm size (rai)							
Mean	15.62	16.00	15.24	13.25	11.19	12.22	21.29
SD	10.08	10.92	9.26	6.48	8.92	7.79	9.08
t-value		-0.504^{NS}		-1.023^{NS}		4.921***	
% land ownership	88.34	84.41	91.88	95.27	79.75	89.11	95.75
Farm type (%)							
Rain-fed	77.78	87.78	67.78	80.00	96.67	88.33	26.67
Partial irrigated	12.22	6.67	17.78	0	0	0	53.33
Irrigated	10.00	5.56	14.44	20.00	3.33	11.67	20.00
Productivity (kg/rai)							
Mean	405.19	420.36	389.26	420.75	453.75	435.86	335.59
SD	104.88	104.61	104.76	44.35	95.92	76.01	121.08
t-value		-1.296^{NS}		1.832*		-4.919***	
Paddy price (THB/kg)							
Mean	9.88	9.08	10.71	11.72	9.60	10.80	10.56
SD	2.03	1.51	2.18	1.90	3.00	2.63	1.01
t-value		5.690***		-3.132***		-0.474^{NS}	
On-farm (THB)	69,610	62,658	76,562	97,414	56,170	76,792	76,103
SD	48,381	45,746	50,173	66,280	38,884	57,749	30,665
t-value		1.943*		-2.940***		-0.061^{NS}	
Off-farm (THB)	28,409	32,973	24,211	32,480	28,353	30,417	11,800
SD	24,186	25,637	21,992	21,357	17,952	19,670	21,402
t-value		-2.358**		-0.810^{NS}		-4.110***	
Total (THB)	98,019	95,631	100,773	129,894	84,523	107,209	87,903
SD	52,297	51,599	53,130	67,376	38,329	58,964	36,506
t-value		0.706^{NS}		-3.206***		-1.640^{NS}	

Note: NS = statistically non-significant,
*, **, *** = significant at 10%, 5% and 1% level, respectively

Sources of farm household income can be divided into on-farm income and off-farm income. The on-farm income comprises from rice production, and from other agricultural activities. Apart from rice income is income from vegetables, orchard and livestock. Moreover, they earn off-farm income mainly from working as labours or employees in non-agricultural activity. The results show that farm household income of organic samples is relatively higher than conventional farms. On-farm income of organic samples is highly significant than conventional farms, due to total farm land and paddy price, while conventional farms have significant difference in average off-farm income (Table 1).

2. Attitude towards organic farming

The opinion is measured by a five-point scale. This scale measures the opinion or reactions of farmers on a set of statements. For example, low cost of production under organic system (1 = strongly disagree, 2 = disagree, 3 = not at all, 4 = agree, 5 = strongly agree). These reactions are analysed and calculated as average score and mode of each statement. Table 2 shows that attitude about specialised markets and premium prices (special price) for organic foods, and special credit (especially on inputs) should be given for organic farming are strongly supported by rice farmers. In addition, farmers are agree on production technique about farmer can produce without chemicals, continuous use of conventional farming technologies induces problem on farm (conventional problem), and organic farming offers a suitable solution of conventional problem (solve problem). While, organic farming become low yield is disagreed.

Table 2. Farmers' attitude towards organic farming.

View on	Average score of attitude (mode)						
	All samples (n=180)	Conv. Samples (n=90)	Organic samples (n=90)				
			Total organic	Non-contract			Contract
				ACFS	ACT	Total	
1) Production technique	4.06 (4)	3.38 (4)	4.74 (5)	4.87 (5)	4.50 (4)	4.68 (5)	4.83 (5)
2) Conventional problem	4.03 (4)	3.68 (4)	4.39 (5)	4.00 (5)	4.27 (4)	4.13 (4)	4.90 (5)
3) Solve problem	4.27 (4)	3.81 (4)	4.73 (5)	4.83 (5)	4.50 (4)	4.67 (5)	4.87 (5)
4) Low yield	2.37 (2)	2.44 (2)	2.29 (2)	1.80 (1)	3.03 (2)	2.42 (2)	2.03 (2)
5) Special price	4.62 (5)	4.51 (5)	4.72 (5)	4.80 (5)	4.73 (5)	4.77 (5)	4.63 (5)
6) Special credit	4.40 (5)	4.39 (5)	4.41 (5)	4.53 (5)	4.33 (4)	4.43 (4)	4.37 (5)

Note: Scalar variable of attitudes, where 1 = strongly disagree and 5 = strongly agree

3. Information and extension method

Information about organic rice farming is very important for the farmers to change their practice, enhance knowledge on farming, production and market situations. Approximately 60 percent of organic rice farmers have got information from extension agents (government and NGOs agents), in form of group meeting. In addition, 18 percent of organic farms have got information from their neighbouring farmers (relatives and friends), while mass media (TV and radio) takes about 14 percent (Table 3).

Table 3. Source of organic information* (%).

	Organic sample (n=90)	Non-contract (n=60)			Contract (n=30)
		ACFS	ACT	Total	
Mass media	13.95	27.63	4.88	19.66	1.82
Extension agent	46.51	34.21	73.17	47.86	43.63
NGOs	16.28	0	0	0	50.91
Merchant	5.24	11.84	0	7.69	0
Farmers	18.02	26.32	21.95	24.79	3.64
Total	100.00	100.00	100.00	100.00	100.00

Note: *farmers can get information from more than one source

Most of organic rice farmers are members of agricultural production group, while only 23 percent of conventional farmers are members of the group. In addition, participation in extension service has a similar result with the groups' member; approximately 90 percent of organic rice farms are participated in extension service on organic farming, while only 3 percent of conventional rice farmers have been done (Table 4).

Table 4. Member of agricultural organisation and participation in extension service.

	All samples (n=180)	Conv. Samples (n=90)	Organic samples (n=90)				
			Total organic	Non-contract			Contract
				ACFS	ACT	Total	
Member of agricultural production group (%)							
Yes	60.00	23.33	97.78	93.33	100.00	96.67	100.00
No	40.00	76.67	2.22	6.67	0	3.33	0
Participation in extension service (%)							
Yes	47.22	3.33	91.11	96.67	96.67	96.67	80.00
No	52.78	96.67	8.89	3.33	3.33	3.33	20.00

Figure 1 shows the number of adopters and the timing of adoption in our sample. The longest observed time in farming until adoption of organic farming is 11 years. An average duration until adoption is 8 years while the shortest duration is 4 years. In year 2001 and 2006 are the year after government gives support for organic project. These may imply that the implementation of policy can increase the adoption tendency of organic farming. Organic farming re-emerged in Thailand in the 1980s, which clearly indicates a demand-driven re-emergence of organic farming.

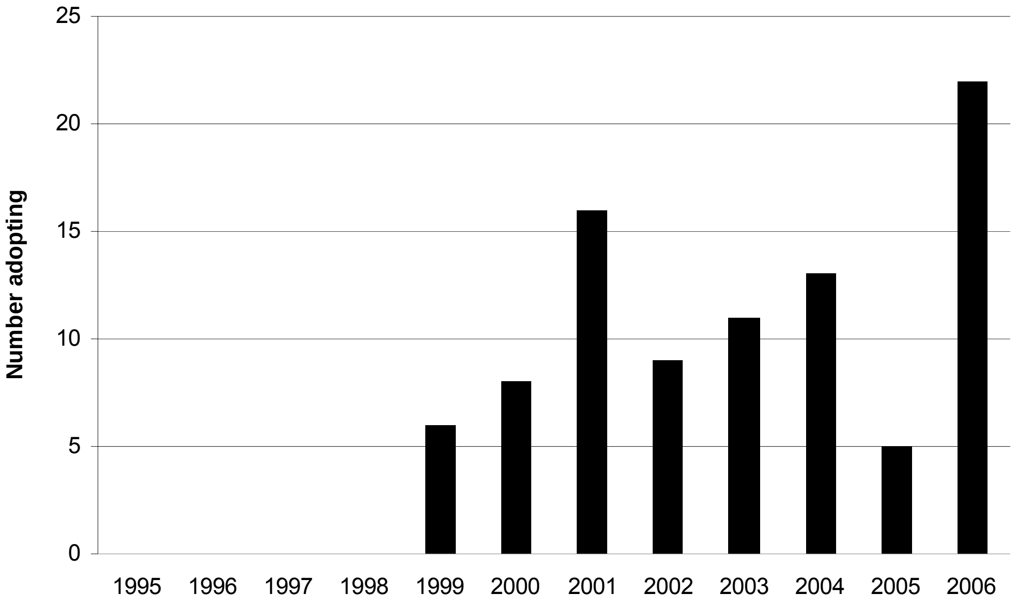

Figure 1. Year of adoption of organic farming in sample, 1999-2006

4. Important factors influencing adoption of organic farming

In certified organic farms, participation in extension service from organic program is very important. According to the derivation of high conventional rice price in crop year 2007/08 affects contract organic price that causes to negative effect of contract farming. Apart from participate in extension service and contract farming what factors are influencing adoption of organic farming is interested. The mean values of the variables are presented in Table 5.

Table 5. Definition and mean value of variables used in the adoption model (n=180)

Variables	Definition	Mean value
Household and farmer characteristics		
EDU	Year of schooling (years)	5.91
DEBT	Amount of loan (THB)	53,278
OFFW[1]	1 for off-farm work	128
	0 for otherwise	52
LTENURE	Land tenure ratio	0.86
Production		
ACWATER[1]	1 for access water during dry period	40
	0 for otherwise	140
FSIZE	Farm size (rai)	15.62
LABOUR	Number of farm family labours (persons)	2.17
Economic		
FGPRICE	Farm-gate price (THB per kg)	9.88
Psychology		
CPROBLEM	Conventional technology induces on-farm problem	4.03
CREDIT	Special credit should be given for organic farming	4.40

Note: [1]each binary variable shows how many farmers are in the category.

In the Cox model, covariates are reported as hazard ratios (Exp(B)). In terms of interpretation a value greater than one has a positive impact on the hazard of adoption, a value less than one has a negative impact and a value of one means no impact.

Table 6. Cox model result for the adoption of organic farming (N=180)

	Hazard Ratio[1]	S.E.	z	p-value
EDU	1.021	0.038	0.54	0.587
DEBT	1.000	0.000	0.89	0.372
OFFW[1]	0.669	0.172	-1.57	0.118
LTENURE	1.371	0.685	0.63	0.527
ACWATER[1]	2.249	0.607	3.00	0.003
FSIZE	0.994	0.013	-0.50	0.616
LABOUR	0.874	0.174	-0.68	0.449
FGPRICE	1.415	0.092	5.34	0.000
CPROBLEM	1.589	0.224	3.28	0.001
CREDIT	1.122	0.157	0.82	0.411
Log-likelihood	-251.04			
Chi^2	66.66		0.000	

Note: [1]Covariates are reported as hazard ratio.

The hazard ratios (Exp(B)) for farm type, farm-gate price, and conventional problem are 2.249, 1.415, and 1.589, respectively. This means that a unit increase in ability to access water, price, and attitude on conventional problem lead to approximately 2.2, 1.4 and 1.6 times increase in the hazards that the farmers will adopt organic farming, assuming that the other variables are constant. Access to water (ACWATER) is the only production variable that shows a significant impact. In rainfed area, the ability to access water conducts to full-year farming, while organic regulation concerns all round year activity. Household labour during rice cultivation (LABOUR) which was expected to positively shift the probability is not significant. Besides, farm size (FSIZE) which was expected to negatively shift the probability, has no significant for diffusion. In general, farm size is regarded as an important determinant of adoption decisions (Feder *et al*. 1985 cited in Läpple 2009), and also Burton *et al*. (1999) found farm size to be significant for organic farming. In term of economic variable, farm-gate price (FGPRICE) has significantly positive impact. As the same way, attitudinal variable (CPROBLEM) is also significantly positive influence, while attitude on credit program (CREDIT) is not significant. Burton et al. (2003) found attitude concern about environmental issues and the belief that organic farming is better for the environment have a strong positive impact on the hazard, whereas those farmers who believe that conventional agriculture can sustain productivity have a much lower hazard. In addition, the hazard ratio for off-farm work (0.669) means that the hazard of organic farms is about 33% lower for farm that a unit increases in working off-farm.

In addition, the organic farmers are asked the opinion on adoption of organic farming. Table 7 represents the opinions of organic rice farmers on influencing factors and their ranks according to the means and mode of each statement. The important factors in all organic groups are demand for healthy food, human and animal health hazards due to use of agro-chemicals is seen as one of the consequences of conventional farming. In contract organic farm, the influencing factors are gaining higher commodity price, and concern with degrading soil fertility and productivity on farm. While low cost of production and independence in farming occur in non-contract farms. In addition, gaining higher commodity price has strong influence for ACFS farms, while less influence in ACT farms. The results imply that health concern factors are very important reason.

Table 7. Influencing factors on decision of adoption of organic farming

Influencing factors	Average score of influencing factor (mode)				
	Total organic (n=90)	Non-contract (n = 60)			Contract (n=30)
		ACFS	ACT	Total	
1) Low cost of production under organic system	3.41 (4)	3.60 (4)	3.30 (3)	3.45 (4)	3.27 (3)
2) Gaining independence in farming	3.43 (4)	3.47 (4)	3.57 (4)	3.52 (4)	3.20 (3)
3) Demand for healthy food through organic farming	3.71 (4)	3.80 (4)	3.70 (4)	3.75 (4)	3.67 (4)
4) Motivational work of extension agent	2.93 (3)	3.07 (3)	2.40 (3)	2.73 (3)	3.37 (3)
5) Working with groups of likeminded farmers	3.17 (3)	3.37 (3)	2.93 (3)	3.15 (3)	3.23 (3)
6) Credit support program for organic farming	2.91 (3)	3.23 (3)	2.43 (2)	2.83 (3)	3.07 (3)
7) Gaining higher commodity price	3.20 (4)	3.53 (4)	2.53 (2)	3.03 (4)	3.57 (4)
8) Concern with degrading soil fertility and productivity	2.34 (2)	2.07 (1)	1.60 (2)	1.83 (1)	3.37 (4)
9) Concern with in-debt and profitability	2.80 (3)	2.57 (4)	2.80 (3)	2.68 (3)	3.07 (3)
10) Human and animal health problem (due to use of agro chemicals)	3.53 (4)	3.27 (4)	3.70 (4)	3.48 (4)	3.60 (4)

Note: Scalar variable of influence, where 1 = no influence and 4 = strong influence.

Conclusion and recommendations

The rice farmers' households have some different characteristics, with statistically significant differences between organic and conventional farms in on-farm family labour, and on-farm and off-farm income. It indicates that the organic farms depend more on agricultural activities income than the conventional farms.

Both organic and conventional rice farmers have similar attitudes on specialised markets and premium prices for organic foods and special credits. Also, farmers agree on production techniques without chemicals and the continuous use of conventional farming technologies induces problems on farm while organic farming is perceived to offer a suitable solution to conventional problems.

Many of the organic farms emerged from farmers who faced with the problems arisen by the conventional farming while premium prices with a market access from contract farming and changing agents are important incentives.

Cox model implies that the early adoption of organic farming relates to water accessibility, ability to seek higher farm-gate prices, and attitudes toward conventional problems. In summary, there is no factor controlling by farmers. However, some factors like off-farm work, price difference, water accessibility, credit support and attitudes on organic farming may be controllable by policies. In addition, opinions about the decision to adopt organic farming shows that influencing factors for all organic farmers are demand for healthy food, and human and animal health problems (due to use of agro-chemicals). However, there is a disparity in opinions between groups and extension goals towards gaining higher commodity prices, low costs of production under organic systems and obtaining independence on farming.

Therefore, promotion of internal input use by increased water accessibility (e.g. small ponds in fields) in order to increase farm activity and income all round year is recommended. Promotion of organic paddy markets at the local level, with fair trading and price guarantees, as well as organic rice markets in country are also necessary. The attitudes towards conventional problems are highly significance for adoption of organic agriculture; therefore, the conductibility on the improvement of problem-solving capacity should be considered in approaches and contents of extension service.

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ORGANIC AGRICULTURE: A WAY FORWARD TO ACHIEVE GENDER EQUALITY IN INDIA

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Abstract

Among several benefits of organic agriculture, emphasis on gender equality is one important aspect which makes it unique as it is believed that it empowers women. This can be contrasted with conventional agriculture, which is said to marginalise women. To understand gender dynamics in organic farming, 111 men and 69 women registered organic farmers were studied using a semi-structured interview schedule and on-farm observations in the context of livestock production activities during 2006-07 in the North Indian state of Uttarakhand, which has embraced organic agriculture by declaring itself as first organic state in India. Land and livestock ownership was mostly with men, whereas income was jointly managed by both men and women followed by women members alone in most of the households. Animal husbandry activities were performed by both men and women, followed by women members of the family, whereas, decision making in animal husbandry activities though reflected plurality, the final decisions in most of the cases rested with men only. This study was not designed to compare the gender dimensions in conventional/traditional farms against organic farms, yet it was observed that women's formal involvement was being encouraged through appropriate policy interventions in the state of Uttarakhand. In particular, the gender sensitisation training imparted by the Uttarakhand Organic Commodity Board (UOCB) appeared to have played key role in making women's participation more proactive and visible. The authors recommend that studies should made to compare the conventional and organic agricultural systems along gender dimensions so as to know to what extent organic agriculture is helping in achieving the millennium goal of gender equality and women's empowerment.

Key words: gender equality, livestock production, Millennium Development Goals, India.

Introduction

Organic agriculture is rapidly growing all across the world, with India too experiencing significant growth. To promote organic farming, a number of initiatives were taken by the Government of India since 10th plan (2002-07) and such activities are being pursued further with more intensity now, mainly looking at increasing prospects for exports of organic agricultural products to western developed countries. The organic land in India is 1.2 million hectares (ranks 7th in the world) constituting 0.6% of total agricultural land and with 677,257 number of producers (Willer & Kilcher 2011). India exported 86 organic products worth US$ 100.40 Million during 2007-08 with 30% growth over previous years (APEDA, 2009). The export figures further rose to US$122 Million in 2009-10 (Figure 1, Rundgren 2011). India's National Standards of Organic Production (NSOP) and accreditation have been recognised by European Commission, Switzerland and also these are considered by the United State Department of Agriculture (USDA) as having equivalence for its National Organic Programme (NOP), indicating significant progress India has made regarding organic farming (Wai, 2007, Willer & Kilcher 2009).

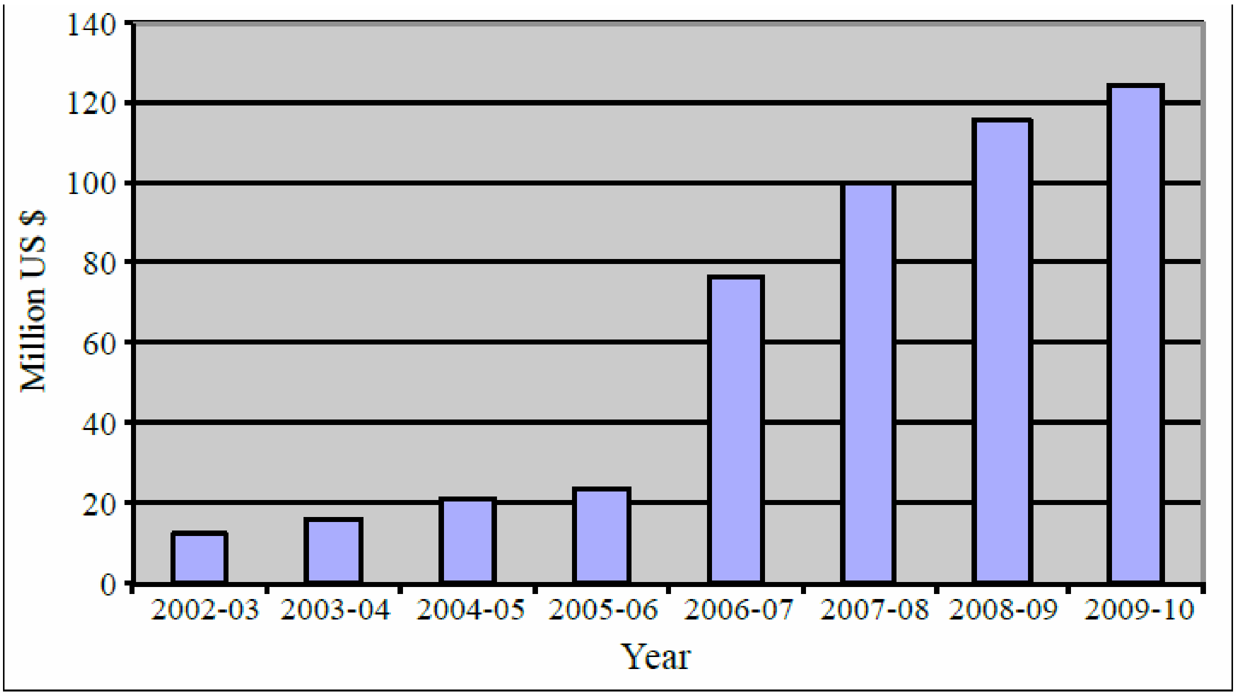

Figure 1. Growing export of certified organic agricultural products from India.

Women and organic agriculture

Women are generally invisible workers as far as agricultural activities in developing countries like India are concerned. Thus, one of the Millennium Development Goals (MDGs) of the member states of the United Nations adopted in 2000 is to promote gender equality and empower women. The ancient African proverb “without women we all go hungry reveal the importance of women in agriculture. They supply much of the labour for agricultural production and perform many activities key to the household economy. In fact, women produce more than half of the food in Latin America and south Asia and 80% in Africa. Although women work as long as men do, there is a real and apparent gender bias with only a few policies oriented to correct the situation (IFOAM, 2007). Organic agriculture has the potential to create situation of more gender balanced agriculture development, since principles of fairness and enforcement of social justice laws minimise the discrimination in agricultural production under organic systems. Organic and sustainable farming has the potential to create new structures that actively work towards achieving women’s empowerment and protecting the use of indigenous knowledge.

The different roles and responsibilities of women and men are closely linked to environmental change through their economic and household activities and in-turn the resulting environmental changes affect people’s well-being. Moreover, organic agriculture may have positive effects on the income of women, who make up a large sharing of smallholding farmers, particularly in sub-Saharan Africa and Asia (ESCAP 2003). Organic agriculture supports gender equality because it makes the women’s contribution more visible, offer economic opportunities, supports health, encourages biodiversity and traditional knowledge, and ensures equitable work standards (IFOAM 2007). A number of analysts have suggested that alternative farming has the potential to create more equitable gender distributions of farm labour and power by challenging productivist agriculture and its associated ideologies. But, there is lack of strong research support for this kind of arguments provided mostly by the proponents of organic farming. The empirical evidences to understand gender differences in access to productive resources remain scarce and the capacity of many developing countries to integrate gender issues in development programmes is also weak. Even where progress has been made, the capacity to implement policies and evaluate impact is often inadequate (FAO 2009). Padel (2001) also pointed out that the empirical evidence on gender issues was scarce, and the role of women in the decision-making in particular has not been studied in detail. Farnworth and Hutchings (2009) has recommended that studies be conducted in the South about how farm women are challenging and contesting gendered spaces in farming, and in so doing working to redefine not only their gender identities, but also the meaning of sustainable farming itself.

Many women around the world are taking a leading role in the development of organic agriculture (IFOAM, 2006), which has an impact on their empowerment. At the production scale, practicing organic agriculture results in more diversified crops grown and different livestock species raised in a farm. The diversity calls for women to play a more diverse role in the household economy and to perform tasks of more responsibility (for example taking care of nursing fields, seed beds or marketing of agric products etc). The added responsibility enhances their self esteem and decision making power, promoting their empowerment within their family and community. Moreover, because organic agriculture requires specific knowledge and specialised skills, women are exposed to more educational and skills development opportunities like on-farm and off-farm trainings.

Organic agriculture's ability to empower women has further beneficial impacts on food security. It has been shown that when women have responsibility over resources, such as land and other productive resources including livestock, they have greater capacity to optimise their use, increasing food production and enhancing the nutritional health of their families (Madeley, 2002).

Duram (2006), in her study on organic farmers in the US, reported that organic farmers are more likely to be female when compared to conventional farmers. Hall and Mogyorody (2007) analysed a large sample of Ontario organic farmers using both survey and case study data, to explain variations in gender participation in farm production and decision making. They found that female farmers on vegetable farms and mixed livestock/cash crop farms were more likely to be involved in farm production than women on field crop farms, where, mechanisation and capital intensive production is much higher. They also examined ideological orientations and motivations, suggesting that farmers with more conventional orientations to organic farming are also less likely to support gender equality. Thus, understanding gender dimensions is an essential part of promoting organic agriculture, which aims at sustainability of farm resources with better environmental outcomes, quality products, and better farm family health.

Organic agriculture in Uttarakhand

A number of initiatives have been taken in India to empower women in all the sectors of economic activity including agriculture. Encouraged by the favourable policy environment at the level of Central government of India, the state governments, especially states with mountain regions are particularly active to devise policies to promote organic farming, as is evident from the fact that three states namely Uttarakhand, Sikkim and Mizoram have already declared themselves as organic states. These states have taken a number of initiatives to give a formal shape and a push to organic farming activities by gearing up the personnel and resources towards organic farming development. Nevertheless, the revolutionary potential of sustainable approaches to farming to reshape our food systems, and the way humans interact with those systems, will not be realised unless there is a concerted effort by committed sustainable farmers and consumers to work towards gender equality.

Indian agriculture is characterised by small scale (<2ha), subsistence farming operations under low input low output production systems, where, livestock are essentially integrated with crop farming. Thus, alongside organic crop production, the prospects for organic livestock production are bright, though yet to be explored (Chander & Mukherjee 2005). In India, Uttarakhand is the pioneering state in organic agriculture, since it is the first state declared as organic. Here, the state government has identified "organic farming" as a thrust area for agriculture development and promoting organic farming through establishment of an institutional mechanism named as Uttarakhand Organic Commodity Board (UOCB). The UOCB was created on 19 May 2003, to promote, co-ordinate, centralise and decentralise the dispersed organic activity in the state (http://www.organicuttaranchal.org). UOCB could facilitate sale of certified organic products US$463,746 during 2003-06 (Subrahmanyeswari & Chander 2007). Though the activities at the moment mainly focus on organic crop production but the interest in organic livestock production is also increasing (Subrahmanyeswari, 2007). Gender relations with respect to faming activities are more or less same worldwide in terms of the way farm work is organised, the way assets such as land, livestock, labour, seeds and machinery are managed and farm decision-making is done. Therefore, in view of the women's significant role in livestock production, role of gender was studied among organic farmers, who were in the process of conversion to livestock farming in the North Indian state- Uttarakhand.

Research methodology

Exploratory research design with multistage random sampling procedure was adopted to select the respondents for the study in Uttarakhand, one of the Northern states of India. At the time of the study in Uttarakhand state, a total of 4,459 organic farmers were registered with UOCB, out of which a sample of 180 farmers were selected randomly from a total of 18 villages, nine blocks from Dehradun, Nainital and Tehri Garhwal districts. Interestingly women farmers represented 38% (69) of the total sample studied. Care has been taken such that the sample represents diverse geographical areas of the state i.e. 110 farmers representing hill area and 70 representing plain area. An interview schedule was developed consisting questions seeking information on gender dimensions. The schedule was modified and validated by pretesting it on a similar population at different location. The selected farmers were personally visited by the researcher during 2006-07 to interview and observe their farm production activities, role and functions of both men and women in terms of attending the livestock activities, their participation in decision-making, the ownership and control over agricultural and livestock assets including income and training received in the matters related to organic agriculture. Statistical analysis was done and data was presented on frequency basis.

Results

Over 75% of the respondents were having 3-6 years of experience in organic farming, followed by 15 per cent of farmers having 6-8 years of experience in organic farming (Table 1). Out of the total 180 households studied, land ownership was with male members (80.56%), while only 19.74 per cent of female respondents had land ownerships in their names (Table 2). Ownership of livestock in majority of cases was with both men and women (48.82%), as against with women in 33.33 per cent households. Management of income from agriculture as well as livestock was jointly by both men and women (47.22%) followed by 30.56 per cent of women members of respective households (Tables 3). Management decisions (Table 4) were taken jointly by both men and women (44.55%) together, followed by women (40.90%), whereas, marketing decisions were taken by men (41.67%), followed by women alone (27.78%). Livestock feeding and health care related decisions were taken mostly by women members of the household (62.22%), followed by joint decisions by both men and women (15.56%). In general, women take the decisions on health care mostly (48.89%), followed by men (22.78%). Women (35%) performed most of the management activities, followed by joint performance of both men and women (27.78 %) Animal breeding activities were attended mostly by men (57.22%) followed by whole family as mentioned by 15.56 per cent of the respondents. Observing the animals for signs of heat and pregnancy was attended by both men and women, whereas, taking the animals for service, selection of breeds was done by men only.

Marketing of livestock products was attended mostly by women (48%) in hill area, whereas, in case of plain area farmers, it's by men mostly (49%). In general, men look after the crop management (62%) and marketing of agriculture produce (65%), whereas, compost application and processing of crop produce were attended mostly by both (36%) men and women together, followed by men in 33 per cent of the households.

Table 1. Training attended in general (organic and conventional)

Number (%) of organic farmers						
Area	Hill area (110)		Plain area (70)		Total (180)	
Gender	M (71)	W (39)	M (40)	W (30)	M (111)	W (69)
Importance of organic farming	71 (100)	39 (100)	40 (100)	30 (100)	111 (100)	69 (100)
Compost making	71 (100)	39 (100)	40 (100)	30 (100)	111 (100)	69 (100)
Crop rotation	71 (100)	39 (100)	40 (100)	30 (100)	111 (100)	69 (100)
Integrated Pest Management	45 (63.4)	20 (51.3)	35 (87.5)	25 (83.3)	80 (72.1)	45 (65.2)
Livestock rearing and health management	31 (43.7)*	08 (20.5)	21 (52.5)	11 (36.7)	52 (46.9)**	19 (27.5)
Feeding practices of cattle	11 (15.5)	08 (20.5)	31 (77.5)*	16 (53.3)	44 (39.6)	24 (34.8)
Clean milk production practices	17 (23.9)	10 (25.6)	38 (95.0)	26 (86.7)	55 (49.6)	36 (52.2)

M=men; W=women, *=significant at 5 % ; **=significant at 1 %

Table 2. Ownership pattern among the farmers

Number (%) of organic farmers									
Area	Hill area (110)			Plain area (70)			Total (180)		
	M	W	Both	M	W	Both	M	W	Both
Land	90 (81.8)	20 (18.2)	--	54 (77.1)	16 (22.9)	--	145 (80.6)	35 (19.4)	--
Livestock	23 (20.9)	35 (31.8)	52 (47.3)	09 (12.9)	25 (35.7)	36 (51.4)	32 (17.8)	60 (33.3)	88 (48.9)
Control over income...									
... from crops	33 (30.0)	36 (32.7)	41 (37.3)	21 (30.0)	18 (25.7)	31 (44.3)	54 (30.0)	54 (30.0)	72 (40.0)
... from livestock	11	38	61	29	17	24	40	55	85

	(10.0)	(34.6)	(55.5)	(41.4)	(24.3)	(34.3)	(22.2)	(30.6)	(47.2)

M=men; W=women

Table 3. Division of labour among organic farmers in livestock farming activities.

	Number (%) of organic farmers					Number (%) of organic farmers			
Area	Hill area (n=110)					Plain area (n=70)			
Activity	M	W	MW	WF	L	M	W	MW	WF
Management	31 (28.2)	40 (36.4)	34 (30.9)	05 (04.6)	0	17 (24.3)	23 (32.9)	16 (22.9)	14** (20.0)
Feeding	05 (04.6)	77** (70.0)	17 (15.5)	11 (10.0)	0	11* (15.7)	34 (48.6)	08 (11.4)	17** (24.3)
Breeding	61 (55.5)	05 (04.6)	13 (11.8)	18 (16.4)	09 (08.18)	42 (60.0)	10* (14.3)	04 (05.7)	10 (14.3)
Health care	19 (17.3)	67** (60.9)	24 (21.8)	00	00	22* (31.4)	21 (30.0)	16 (22.9)	03* (04.3)
Marketing	23 (20.9)	53** (48.2)	25* (22.7)	09 (08.2)	00	34** (48.6)	19 (27.1)	07 (10.0)	10 (14.3)
Grazing	11 (10.0)	09 (08.2)	11 (10.0)	17 (15.5)	62 (56.36)	07 (10.0)	06 (08.6)	11 (15.7)	12 (17.1)
Compost making	40* (36.4)	23 (20.9)	35 (31.8)	12 (10.9)	--	16 (22.9)	11 (15.7)	39** (55.7)	06 (08.6)
Crop management	69 (62.7)	11 (10.0)	30 (27.3)	--	--	43 (61.4)	11 (15.7)	16 (22.9)	--
Manure/compost application	31 (28.2)	24 (21.8)	45** (40.9)	10 (9.1)	--	29 (41.4)	09 (12.9)	11 (15.7)	21** (30.0)
Crop produce processing	20 (18.2)	35* (31.8)	46 (41.8)	09* (8.2)		40** (57.1)	11 (15.7)	19 (27.1)	--
Marketing of produce	68 (61.8)	11 (10.0)	16 (14.6)	15 (13.6)	--	49 (70.0)	05 (07.1)	11 (15.7)	05 (07.1)

*=significant at 0.01 level of probability; **=significant at 0.05 level of probability, M=men, W=women, MW=men & women, WF=whole family, L=Labour

Table 4. Participation in decision-making.

	Number (%) of organic farmers					Number (%) of organic farmers				
Area	Hill area (110)					Plain area (70)				
Activity	M	W	MW	WF	Ao	M	W	MW	WF	Ao
Management	16 (14.6)	45 (40.9)	49 (44.6)	00	0	19 (27.1)*	20 (28.6)	31 (44.3)	0	0
Feeding	12 (10.9)	78 (70.9)**	20 (18.2)	00	0	11 (15.7)	34 (48.6)	08 (11.4)	17 (24.3)	0
Breeding	61 (55.5)	23 (20.9)	13 (11.8)	13 (11.8)	0	42 (60.0)	10 (14.3)	14 (20.0)	04 (05.7)	0
Health care	19 (17.3)	67 (60.9)**	24 (21.8)	00	0	22 (31.4)*	21 (30.0)	16 (22.9)	11 (15.7)**	0
Marketing	41 (37.3)	31 (28.2)	29 (26.4)*	09 (08.2)	0	34 (30.9)	19 (27.1)	7 (10.0)	10 (14.3)	0
Crop rotation	55 (50.0)	31 (28.2)	24 (21.8)	00	0	27 (38.6)	19 (27.1)	24 (34.3)	0	0
Preparation & use of compost	69 (62.7)	11 (10.0)	30 (27.3)	--	--	43 (61.4)	11 (15.7)	16 (22.9)	--	--
Marketing of produce	45 (40.9)	24 (21.8)	31 (28.2)	10 (09.1)	--	29 (41.4)	09 (12.9)	21 (30.0)	11 (15.7)	--

*=significant at 0.05 level of probability; **=significant at 0.01 level of probability, M=men, W=women, MW=men & women, WF= whole family, Ao= any other

Discussion

Gender has been defined by IFAD as “the socio-economic and evolving roles and functions of men and women as they relate to and complement each other within a specific socio-cultural and economic context”. Gender sensitisation has been an important component of the training imparted by UOCB to the organic farmers, which appeared to have some positive impacts in matters related to women’s involvement in activities out of their traditional, often invisible domains like cleaning of cattle sheds, processing of farm produce and post harvest activities. The exposure visits organised by the UOCB for the organic farmers including ensuring good participation of female farmers in training programmes and visits might have resulted in self dignity and an enhanced self esteem among women farmers, who do most of the agricultural operations in India in general and mountainous regions in particular.

Indigenous women over the world have traditionally played a key role in biodiversity management and sustainable agriculture (Jiggins 1994; Shiva and Dankelman, 1992). Some indigenous women hold important roles in the preservation of biodiversity and specific forms of knowledge pertaining to biodiversity and sustainable agricultural practices. The present study revealed that most of the feeding and health care activities of livestock were attended by women members of the family in majority with the knowledge transferred to them since generations together. Although all household members are involved in livestock production, gender discrimination denies women access to resources, rights and services. Nevertheless, the potential benefits of gender equality have made the livestock sector a privileged entry point for gender mainstreaming. Moreover, Organic and sustainable farming has the potential to create new structures that actively work towards achieving women's empowerment and protecting the use of indigenous knowledge. The further analysis of gender relations in the division of labour, access to resources, production of crops and income from their sale is essential for sustainable investment programmes. To protect natural resources, rural women and men must be empowered to participate in decisions that affect their needs and vulnerabilities. Addressing the gender dimensions of natural resources management will help policy makers formulate more effective interventions for their conservation and sustainable use. The principles of organic agriculture especially the principles of care and fairness offers hope for gender equality, if implemented in true spirits.

Conclusions

This study was not designed to compare the gender dimensions in conventional/traditional farms against organic farms, yet it was appreciable that women's formal involvement was being encouraged through appropriate policy interventions in the state of Uttarakhand. Men and women, both were involved in organic agriculture activities, but the final decisions in most of the cases rested with men only. This scenario commonly exists in case of conventional farms as well. An alternative orientation to organic farming has the potential to alter gender relations in agriculture, both by creating a labour process context in which women can more readily participate in farm production and management (Clement and Myles 1994) and by introducing and promoting alternative ways of thinking that are more consistent with gender equality. FAO (2009) has placed gender equality in access to resources, goods, services and decision-making among its key strategic objectives in agriculture and rural development. By creating social relations, gender equity aims at improving gender relations and gender roles and achieving gender equity. Development must encompass rural women's long-term needs and aspirations, their decision-making power, access to and control of critical resources such as land and their own labour. With this background, the authors conclude that organic farming has potential to promote gender equality and empowerment of women, which is very much required for socio-economic upliftment of women in developing countries in particular.

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A LABORATORY STUDY OF SOIL CARBON DIOXIDE EMISSIONS IN A VERTISOL AND AN ALFISOL DUE TO INCORPORATING CORN RESIDUES AND SIMULATING TILLAGE

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Abstract

Soil organic carbon (SOC) is reduced in annual horticultural systems due to accelerated CO_2 emission from the frequent and intensive tillage required to prepare beds and manage pests. Conversely, crop residue incorporation has the potential to counteract the loss of SOC. We hypothesised that vegetable systems could be made more resistant to SOC loss by including a high-residue grain crop such as sweet corn (*Zea mays* var. *rugosa* L.) in the rotation. We incubated two Australian soils, an Alfisol and a Vertisol, in plant-free sealed chambers with a ± corn residue treatment and soils either sieved/disturbed or not to simulate tillage. Carbon dioxide-carbon (CO_2-C) flux was measured using air samples collected at 24 hours before , and 1, 120, 240 and 360 h after simulated tillage. Residue incorporation had a larger effect on CO_2-C flux than tillage for both soil types. The tillage x residue interaction accounted for 40% of CO_2-C flux; the effect of residue was highly significant but tillage alone was not significant. The effect of simulated tillage on residue incorporated soil was most stimulatory and the treatment without residue or without simulated tillage was the least stimulatory to CO_2 emission. Residue effects were 22% higher in the Alfisol compared with the Vertisol whilst tillage effects were 26% higher in the Vertisol than in the Alfisol. The Vertisol was more resistant to CO_2 losses than the Alfisol after disturbance as the gas fluxes stabilised more rapidly following soil disturbance. In summary, residue incorporation and tillage interactions were a function of soil type, and fine-textured soils such as the Vertisol may be less prone to CO_2 losses than lighter-textured soils.

Keywords: soil organic carbon, organic vegetable, weed control, Alfisol, Vertisol.

Introduction

Annual horticultural systems commonly rely on frequent and intensive tillage to prepare beds and manage weeds and insects. Tillage stimulates the loss of soil organic carbon (SOC) through accelerated CO2 emission brought about by improvement in soil aeration and soil and crop residue contact (Angers *et al.* 1993) and disruption of soil aggregates exposing the physically protected soil organic matter (SOM) to decomposition (Six *et al.* 2000; Mikha and Rice 2004). Yet despite these disturbances, some vegetable farmers use green manures, organic inputs (e.g. compost, mulch) and crop residues to perform various functions including increasing SOM. Crop residue management systems that maintain organic materials in situ can benefit SOM (Liu *et al.* 2009; van Groenigen *et al.* 2011).

The effects of tillage and crop residue management can have opposing influences on SOC and may be difficult to isolate (Liu *et al.* 2009, Dong *et al.* 2009; Dalal *et al.* 2011). For practical assessment, quantification of effect of each of the two practices individually is desirable to enable evaluation of their contributions separately (Liu *et al.* 2009). Luo *et al.* (2010) summarised the data from 39 published papers for Australian conditions on the interaction of stubble retention and/or conservation tillage on soil C change in the surface 0.1 m of soil. They have shown that the synergistic effect of combining stubble retention and conservation tillage increased SOC content by 16.37% as compared with stubble burning and conventional tillage.

The SOC pool in the soil is the balance of C inputs in the form of crop residue and biomass, and C outputs such as CO_2 emissions and other losses. The CO_2 fixed in plant biomass by photosynthesis is returned to soil forming SOM, some of which is lost due to tillage (Jarecki and Lal 2003; Johnson *et al.* 2007). Vegetable systems are especially vulnerable to rapid SOC losses because of a heavy reliance on intensive tillage. We hypothesised that SOC losses from soils in such systems could be reduced by including a high-residue grain crop like sweet corn (*Zea mays* var. *rugosa* L.) in the rotation. The subsequent corn stover input in the soil could balance the expected loss of SOC due to tillage.

This laboratory study was conducted to separate the effects of residue incorporation and tillage in an associated field trial where sweet corn stover incorporation in a corn-cabbage (*Brassica oleracea* L.) rotation had a positive effect on SOC, but no differences in SOC for organic and conventional soil management systems. Organic vegetable systems rely on tillage for weed control, whereas conventional systems rely on herbicide. This paper is an extended version of a conference paper presented at the Fifth World Congress in Conservation Agriculture (Bajgai *et al*. 2011).

Materials and methods

Soils from 0-0.1 m depth were collected from two contrasting cropping sites: a self-mulching black clayey Vertisol and sandy brown Alfisol (Soil Survey Staff, 2010) from the Armidale area of New South Wales, Australia (latitude 30.48°S, longitude 151.65°E, elevation 1063 m). Selected properties for the two soils are presented in Table 1. The soil samples were air-dried, sieved through <2 mm sieve, plant debris removed and homogenised by mixing. We used plant-free examples of an Australian Alfisol and a Vertisol in our experiment. Five hundred (Vertisol) and 600 (Alfisol) grams of soil (oven-dried basis) were weighed into 0.86 m diameter polythene pots to a depth of ~0.1 m.

Table 1. Selected soil properties for 0-0.1 m depth with means (n = 4).

Soil property	Alfisol	Vertisol
Carbon (g $100g^{-1}$)	1.28	2.47
Nitrogen (g $100g^{-1}$)	0.12	0.21
pH (H_20) 1:5	6	5.8
Bulk density (Mg cm^{-3})	1.47	1.22
Sand content (g $100g^{-1}$)	72.4	24.4
Silt content (g $100g^{-1}$)	11.3	13.9
Clay content (g $100g^{-1}$)	16.3	61.7

A three-way factorial design: (1) ground (<4-mm) stover incorporation (+RES or -RES), (2) simulated tillage (+Till or –Till), and (3) soil type (Vertisol or Alfisol) was used with four replicates in a completely randomised layout. The –RES –Till treatment was considered analogous to a conventional soil management system and the +RES +Till treatment was considered analogous to an organic soil management system. The +RES treatment was amended with 15 tonnes ha^{-1} (dry weight basis) of stover with an average carbon:nitrogen ratio of 34:1, and pre-incubated at 25°C for four months to allow decomposition of the applied residue.

During pre-incubation, water was applied once in two weeks for Vertisol and once every six days for Alfisol to bring soil moisture levels from wilting point (-1500 kPa) to field capacity (-33 kPa). At the end of pre-incubation, i.e., when treated soils dried closer to wilting point, the soils were sieved to simulate tillage (Calderon *et al.* 2000; Kristensen *et al.* 2003) through a <4-mm mesh. A pictorial summary of the methodology adopted is shown in Figure 1.

The sieved soil was then repacked into the pots and the pots were placed in sealed PVC tubes for headspace air sampling. The air samples were drawn through a rubber septum inserted on the cover using a surgical needle mounted on a syringe. The air samples were taken before covering and 30 minutes after covering, and the difference in concentrations was calculated as the flux of CO_2. The air samples were stored in evacuated vials and analysed with a gas chromatograph. Air samples were collected 24 hours (h) before the simulated tillage treatment, and 1, 120, 240 and 360 h after the tillage treatment. Analysis of variance was used to assess the effects of residue, simulated tillage, soil type and time of sampling on CO_2-C flux using the statistical package R version 2.9.1 (R Development Core Team 2010). The data were log transformed to stabilise variances. *P*-values ≤ 0.05 were considered significant.

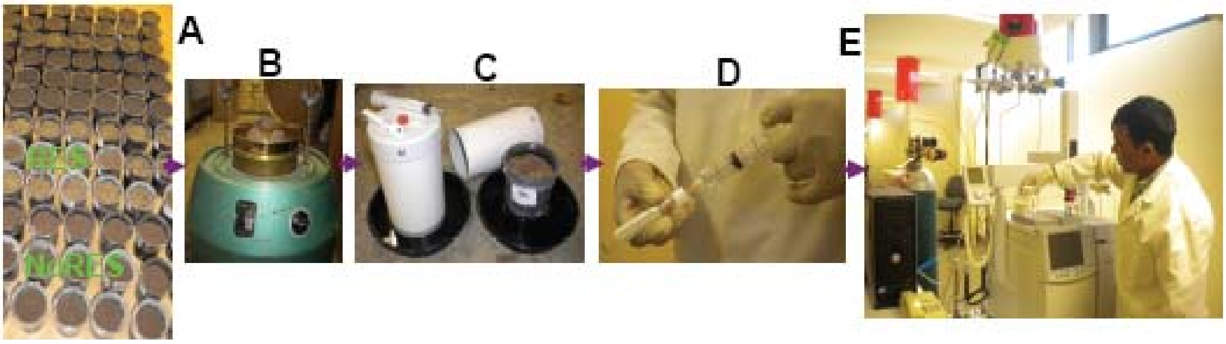

Figure 1. Summary of the methodology: (A) treatments prepared, (B) < 4 mm sieve mounted on sieve-shaker to simulate tillage, (C) sealed chamber used for headspace gas sampling, (D) samples in evacuated vials and (E) sample analysis by gas chromatograph.

Results and discussion

The analysis of variance indicated that CO_2-C flux varied significantly over time and residue treatment ($P < 0.001$) Tillage treatment and soil type were not significant ($P \geq 0.28$). The following interactions were significant: soil type x time, soil type x residue incorporation and residue incorporation x tillage ($P \leq 0.014$). Initial CO_2-C flux levels at -24 h were largely not significant across soil types and treatments (average ~11 mg $m^{-2}h^{-1}$), with large increases at 1 h to ~ 76 mg $m^{-2}h^{-1}$ on average, followed by a decline to pre-tillage levels (slightly higher in Alfisol) at 120, 240 and 360 h. The +RES+Till treatment was most sensitive to flux of CO_2-C followed +RES-Till treatment in both soil types in first 1 h after the tillage treatment. Figure 2 demonstrates that the CO_2-C flux was highest for the +RES+Till treatment and was least for the -RES-Till treatment.

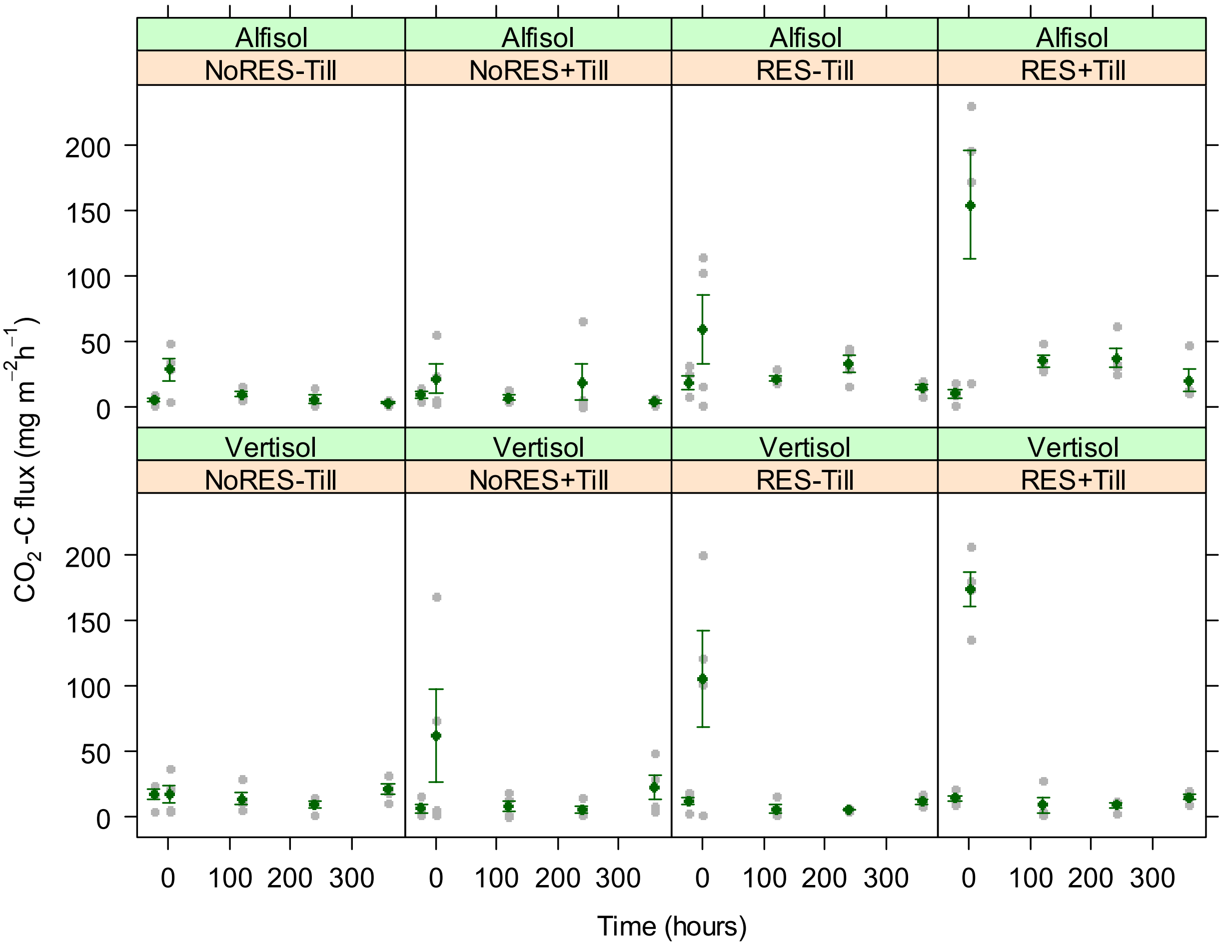

Figure 2. CO_2-C flux for four treatments in Alfisol and Vertisol soils after simulated tillage. The grey dots are raw data points and the vertical bars are standard errors of means.

The soil type x residue interaction was highly significant due to +RES producing 73% and 48% more flux for Alfisol and Vertisol, respectively, in comparison to –RES, indicating a higher rate of residue mineralisation in the Alfisol, presumably due to increased O_2 and CO_2 exchange (Wuest *et al.* 2003) in the sandier soil. When the effect of the tillage and residue was isolated, the residue treatment was highly significant mainly due to residue-derived flux (Kuzyakov 2006) but the simulated tillage was insignificant. Greater fluxes at 120 and 240 h in Alfisol than Vertisol are also likely to be due to greater porosity allowing more gas exchange in the non-swelling sandy soil. The higher flux at 360 h for Vertisol was possibly due to increased porosity (shrinking in response to drying) and/or delayed stimulation of microbial respiration (Wuest *et al.* 2003).

The residue x tillage interaction was based on a lack of tillage effects in –RES, but 40% more CO2-C flux in +RES for +Till than -Till as soil disturbance facilitates better in soil aeration and soil and crop residue contact for C mineralisation (Angers *et al.* 1993). This is because of the improved availability of O_2 and the exposure of more decomposition surfaces, thereby stimulating increased microbial activity (Beare *et al.* 1994). Compared with –RES-Till, tillage alone increased flux by 16%, less than the effect of residue alone (52% increase in flux). The -RES-Till treatment (scenario of conventional vegetable) emitted 70% less CO_2-C flux than +RES+Till (organic scenario), indicating that the effects of tillage and residue alone were largely additive. These trends are corroborated by findings for laboratory (Calderon *et al.* 2000; Wuest *et al.* 2003) and field trials (Ellert and Janzen 1999; La Scala *et al.* 2006; Gesch *et al.* 2007) in terms of CO_2-C flux peaking within hours after disturbance and dropping down later, irrespective of residues being applied or not. Roberts and Chan (1990) had shown similar results for Australian Alfisol. The cumulative proportional CO_2-C flux (Figure 3) shows the strong initial effect of +RES in the Vertisol compared with the Alfisol.

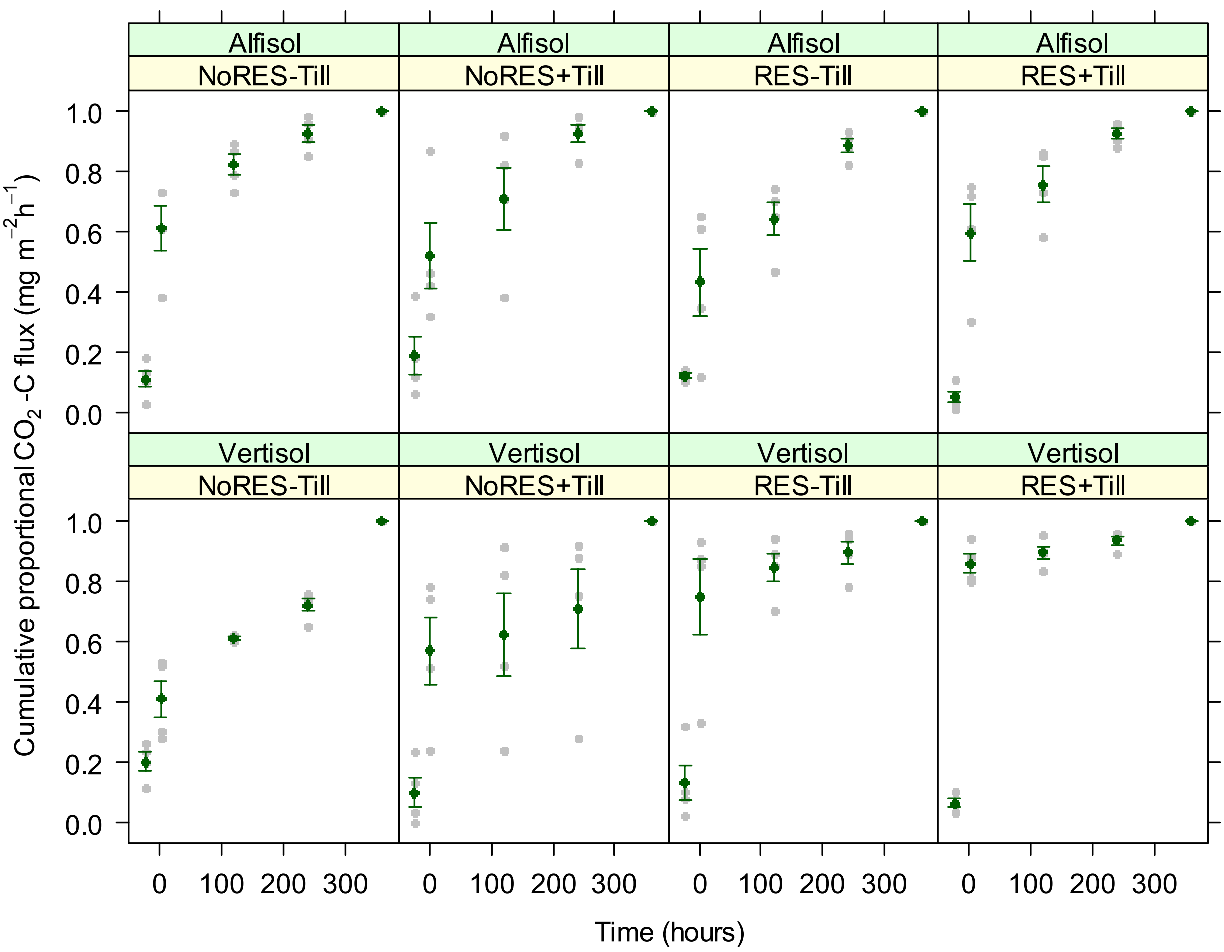

Figure 3. Cumulative proportional CO_2-C flux (standardised by the maximum flux for each treatment combination) for four treatments in Alfisol and Vertisol soils after simulated tillage. The grey dots are raw data points and the vertical bars are standard errors of means.

However, we could not directly compare the magnitude of our CO_2-C fluxes as we were using cultivated soil with or without residue incorporation, and used a different intensity of simulated tillage than in the cited literature. A portion of the added C is lost as CO_2, especially with tillage, but SOC will still be higher than -RES treatments (van Groenigen *et al.*, 2011) due to remains from the incorporated residue. Cumulative CO_2-

C fluxes were generally in order of NoRES-Till < NoRES+Till < RES-Till < RES+Till for both soil types (Figure 4). Residue effects were 22% higher in Alfisol compared to Vertisol whilst tillage effects were 26% higher in Vertisol compared to Alfisol.

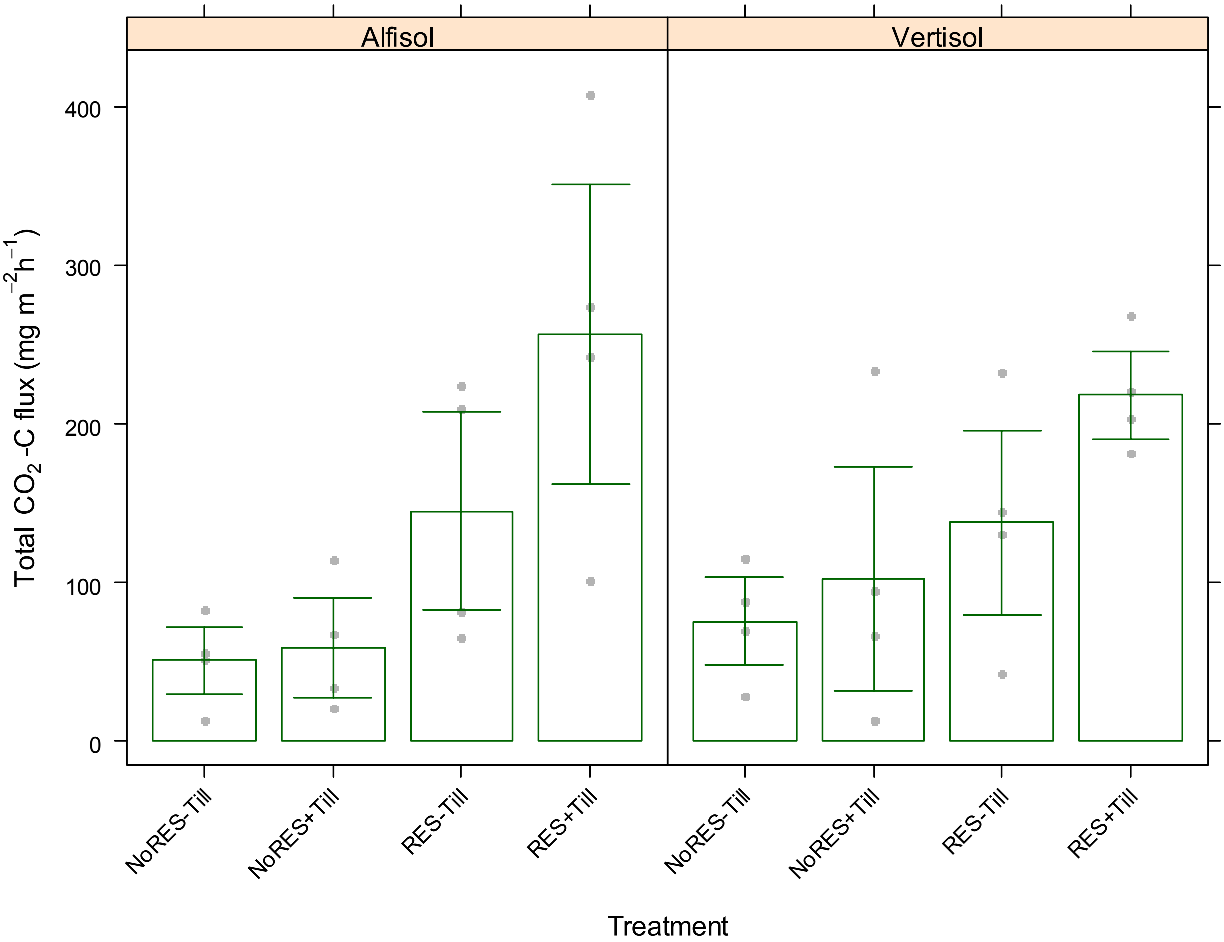

Figure 4. Cumulative CO_2-C flux for Alfisol and Vertisol soils. The grey dots are raw data points and the vertical bars are standard errors of means.

The cumulative fluxes in Figure 3 and Figure 4 demonstrate two advantages of not disturbing soil. Firstly, the +RES+Till treatment evolved a significantly higher flux of C than the +RES-Till treatment and so soil in the +RES-Till treatment may act as sink of CO_2, but soil in the +RES+Till treatment acts as a source. The cumulative plot clearly demonstrates the statistical differences between disturbed and undisturbed soil where residue had been incorporated. Secondly, the treatments without corn residue and without simulated tillage will have more soil carbon compared to the treatments without residue but tilled because less is CO_2 being released from the same baseline level. It is easy to visualise this fact by plotting the extra CO_2-C flux over the –RES-Till (control here) treatment (Mondini *et al.* 2007). The extra CO_2-fluxes to show that Vertisol is more resistant to SOC losses after disturbance than the Alfisol as the downward trend of flux over the measurement time, whilst the Alfisol show an upward trend, indicating its lower resilience being sandy and porous to gas exchanges facilitating microbial respiration.

Some of the shortcomings of this research are related to the frequency and duration of data sampling with respect to time after stimulated tillage. We measured flux at -24, 1, 120, 240 and 360 h after the tillage treatment and were not able to capture the rate of decrease of flux between 1 and 120 h after simulated tillage.

Conclusions

Residue incorporation had a larger effect on CO_2-C flux than tillage for both soil types, suggesting that C availability and form can be more important than disturbance in cropping soils. The interactive of tillage x residue contributed 40% of CO_2-C flux, however, when the effect of the tillage and residue was isolated, the residue treatment was highly significant mainly due to residue-derived flux (Kuzyakov 2006) but the simulated tillage was insignificant. The +RES+Till treatment had a significantly higher flux of C than the +RES-Till treatment, with the former treatment acting as a CO_2 sink and the latter acting as a CO_2 source. The residue effects were more pronounced in the Alfisol whilst tillage effects were more pronounced in Vertisol. The Vertisol soil was found to be more resistant to SOC losses than the Alfisol after disturbance as the gas fluxes stabilised more quickly. The Alfisol soil was less resistant to SOC losses based on its sandy and porous characteristics for gas exchanges, facilitating increased microbial respiration and subsequent CO_2 losses from the soil. In summary, residue incorporation and tillage interacted differently in the different soil types, and fine-textured soils such as the Vertisol may be less prone CO2 losses than lighter soils

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BOOK REVIEW

Jones, Rebecca (2010) Green Harvest: A History of Organic Farming and Gardening in Australia. CSIRO Publishing, Melbourne.

Green Harvest is an introduction to four Australian organic farmers and gardeners. Each example is framed within the context of an historical account which is itself subsumed within Jones' own "four key principles" of organics. At the outset, the author alerts us to her view that "History is both fact and fiction" (p.ix). It is a novel approach which will not appeal to all, and will be unsettling for some. The author states that: "Environmental history is the lens through which I have examined organic growers' changing ideas about health and environment" (p.ix).

The author claims that: "I have identified four key principles, each founded on organic farmers' and gardeners' belief in the dependence of health on the biophysical environment. These four principles are: soil, chemical-free growing, ecological wellbeing and back to the land" (p.xiv). In this five chapter book, these four "principles" provide the headings for the first four chapters, and each of these chapters carries a "case study", each of which is based on one or several interviews.

The first case study is an account of Harold White (1883-1971) a grazier from Guyra, northern NSW. White was involved with Australia's pioneering organic farming society, the Australian Organic Farming and Gardening Society (1944-1955). Since he apparently did not forgo superphosphate entirely he would not qualify as certified organic today. In White's time there was no certification and Jones informs us that, as with the subjects of her Chapter 2 case study, "they sold their produce on the open market" (p.115). Jones' account relies on White's writings along with interviews with family members. This approach perhaps accounts for discrepancies such as, for example where Jones states that, from World War I, White "returned to Australia in 1919, now a colonel", whereas the *Australian Dictionary of Biography* states that he achieved the lesser rank of lieutenant-colonel, and some years after his return (Mitchell, 1990).

Chapter 2, presents the case study of the retired Tasmanian dairy farmers, Ray and Elma Mason. Ray describes a health scare "I was only thirty-eight. I had three days in intensive care. We had sick cows, a big mortgage and I was crook" (p.47-8). Jones states that "When Ray had recovered enough to return to work he decided he had to change both his farming practices and his diet" (p.48). The pair joined the Tasmanian Organic Farming and Gardening Society. They took the advice of South Australian organics advocate, Peter Bennett, and they switched from superphosphate to dolomite. The Masons also listened to Alex Podolinsky whom Jones describes as "one of Australia's first biodynamic farmers" (p.51).

Chapter 3 is the case study of a broadacre certified organic cereal and sheep farmer, Anthony Sheldon, working the semi-arid country of the Mallee, on the border of South Australia and Victoria near Pinnaroo. With a landscape of sand over clay, "Clover and medic, claims Sheldon, are the key to organic production on this farm" (p.72). He is reported as stating that: "The real winner with organics is that you are not using toxic inputs. That means it is safe for people who produce the food and no one in the production line gets exposed to anything that could be harmful" (p.72). Sheldon has planted over 25,000 trees in vegetation belts on what he described as previously "1280 acres ploughed in one big chunk … a broadacre desert" (p.76). An account of Sheldon's transformation of his land was produced by the Museum of Victoria (Dale, 1996).

In Chapter 4, Jones states that "Back to the Landers came from the countercultural movement of the late 1960s and 1970s" in pursuit of "a self-sufficient rural idyll" (p.87). The Australian periodicals *Earth Garden* and *Grass Roots*, founded in 1972 and 1973, supported these goals. Jones quotes from a 1973 issue of *Grass Roots*: "More people are concerned about the chemicals they consume with their food and the pollution all around them" (p.88). According to Jones, "Jackie French was a classic Back to the Lander" who has "created a contemporary version of organic self-sufficiency" (p.104). We are informed that French is the gardening editor of the Australian magazine *Women's Weekly*, that "she is flexible about the use of chemicals" and that "The word 'organic' is rarely mentioned" (p.111).

In the final chapter, 'Australian organic farming and gardening in the 2000s', Jones claims that "Among gardeners, organic methods have become an orthodoxy" (p.113). In this chapter, a convert to organic farming, Matthew Jamieson, shares his poignant perspective: "All my family have died of cancers. By the time I was 34 I was the oldest of my descent line. I grew up at the stage when everyone was spraying 245T and everyone in our rural community had stillborn babies" (p.119).

There is an odd disclaimer inserted somewhat incongruously within the final chapter: “There is currently no evidence confirming the presence or absence of health and environmental effects of genetically modified organisms” (p.120). This claim is reminiscent of other CSIRO publications, for example: “No adverse effects on human health and safety or the environment have been reported in connection with any of these [GMO] releases” (CSIRO, 2002, p.12). Despite public outrage, the CSIRO is a strong advocate of GMO food crops and this is controversial beyond the organics sector (e.g. Dean, 2011). The Australian organics pioneer and subject of Chapter 1, Harold White, complained that: “here in Australia, the universities and Departments of Agriculture have neglected it, while boosting fertilisers in season and out of season. Indeed, one professor suggested a campaign against the advocates of organic farming before a gathering of C.S.I.R.[2] people and was applauded” (White and Hicks, 1953, p.95). Health and environmental impacts of GMOs have been extensively documented, for example, by Jeffrey Smith (2003, 2007).

There are some serious omissions in this book for those seeking, what the subtitle appears to promise, namely, a history of organic farming and gardening in Australia. There is no mention of the biodynamic pioneers in Australia who, as early as the late 1920s, were members of the worldwide Agricultural Experimental Circle, founded at Rudolf Steiner’s Agriculture Course at Koberwitz (Kobierzyce) in 1924 (Paull, 2011). The sole “Archival source” reported in *Green Harvest* is of a 1949 bread enquiry, while no reference is made to Australia’s two organic association archives, that of the Living Soil Association of Tasmania (LSAT) held by the State Library of Tasmania and that of the Soil Association of South Australia (SASA) held in the State Library of South Australia (Paull, 2009a, 2009b). Material might usefully have been drawn from the history of the Organic Gardening and Farming Society of Tasmania written by Graeme Stevenson (2009). The mass-marketed and nationally distributed book *Organic Gardening* by Audrey Windram (1975) deserves a place in any history of organics in Australia, because of the book’s precedence, and its probably unrivalled reach. The important milestone events of the founding of Australia's two main organics certifiers, Biological Farmers of Australia (BFA), and the National Association of Sustainable Agriculture Australia (NASAA) in the late 1980s warrant analysis. Australia and New Zealand’s *Journal of Organic Systems* has been publishing since 2006, it is neither mentioned nor cited. The 15th IFOAM Organic World Congress held in Adelaide in 2005 brought together the world’s leading organics scholars and advocates, it was the first time this triennial event had been held in the Southern hemisphere and is an organic milestone that belongs in any comprehensive history of organic agriculture in Australia. Besides Jones’ four principles, it would be fair to cite the ten principles well articulated by the AOFGS organics pioneers in their statement of objectives (reproduced in Paull, 2008) and the four organics principles formulated by the International Federation of Organic Agriculture Movements (IFOAM, 2006).

Of the 160 countries that practice organic agriculture, Australia accounts for approximately one third of the world’s total of certified organic agriculture hectares (Willer and Kilcher, 2011). It is an achievement that earns Australia some ‘bragging rights’ and a claim to an enduring interest in the history, as well as the present and future, of its organics sector. Green Harvest offers a modest contribution to the understanding of Australia’s organics history.

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[2] Australia□s CSIR was renamed CSIRO (Commonwealth Scientific and Industrial Research Organisation) in 1949 (CSIRO, 2008).

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