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Full Length Research Paper

Analytical maintenance practice of income generation in GRA fields and organic farming in India

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In past decades, agricultural development majorly focused on short term productivity based on external inputs resulting in neglect and improper use of natural resources. Thus, it leads to ecosystem damage and loss of food security. This has forced the farmers, scientists and the policy makers to look at sustainable farming techniques through organic farming. In India there is greater possibility of bringing green revolution agricultural areas under the gambit of sustainable farming/organic farming. Research and development is necessary to better understand the complex ecological processes as well as the management capacity of farmers. Hence, this research study was done to analyze the reach and adaptation level of sustainable farming techniques by organic farmers and non- adoption (sustainable farming techniques) reasons among the Green Revolution Agriculture (GRA) farmers at farm level. This will help us to find different strategies to popularize sustainable organic farming among the farmers in order to overcome food crisis.

Key words: Agriculture, organic farming, sustainable farming techniques.

INTRODUCTION

The interest in the sustainability of agricultural food systems, traced to environmental concerns, began in the 1950s to 1960s. However, ideas about sustainability date back at least to the oldest surviving writings from India, China, Greece and Rome (Pretty, 2008; Dhama et al., 2005; Sofia et al., 2006; Balasubramanian et al., 2009). Today there is a need of sustainable agricultural technologies and practices that: (1) Do not have adverse effects on the environment that is, partly because the environment is an important asset for farming, (2) are accessible to and effective for farmers, (3) lead to both improvements in food productivity and have positive side effects on environmental goods and services. Sustainability in agricultural systems incorporates concepts of both resilience that is, the capacity of systems to buffer shocks and stresses, and persistence that is, the capacity of systems to continue over long periods. This culminates in many wider economic, social and environmental outcomes (Pretty, 2008; Bradford and Wichner, 2009).

Sustainable farming techniques refer to an ecological production management system that promoters and enhances ecosystems, biodiversity, biological cycles and social-economic status of the farmers. It is based on the minimal use of off-farm inputs and management practices that restore maintain and enhance ecological harmony (Vandermeer et al., 1998; Xu et al., 2000; Greene and Kremen, 2003). In adapting the sustainable farming techniques the nature of the profile respondents place a major role and that determines their adaptation level. The respondents profile characteristics greatly altered the adoption of scientific management techniques (Bhandari et al., 2007). By examining a farmer's profile characteristics, one can determine the level of acceptance or the understanding the community has towards sustainable agricultural production. Interviews conducted with farmers indicated the utmost importance of community involvement to help diversity both the types of interactions in a community as well as types of activities the farmer is involved in, both suggesting an increase in work/life balance for a farmer, an important contributor to farm financial stability as well (Carruthers, 2003; Burton et al., 2003).

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Figure 1. Location of the study sites.

According to Unilever (2003), the challenge of using natural resources sustainably is fundamentally a social one and decisions made on the farm have effects on the local community. The interests of community groups and local inhabitants must be considered during the planning and development stages of agricultural activities when these developments directly affect their living situation. Profile characteristics of a community are a concept measuring a unified and cohesive community in which the connection to agriculture and land is strong (Martin et al., 2003).

Decision making on how to achieve the best of objective is affected by various variables including labor availability, land tenure, skill and social status (Harris, 1996). Generally higher social standing of a person depends on the large land he posses in which he can grow more crops and get more income as a return (Smitha, 2004; Saravanapriya, 2005).

Age, education level, occupational status and com-munity status also affect social standing and adoption level of technologies (Shanthasheela, 2001; Smitha, 2004; Saravanapriya, 2005). As in any com-munity, profiles can be influenced by a person's degree of social standing which includes the ability to have access to credit and work attitude. With higher social status, a farmer is more likely to own extra land or have access to other land. Also, he likely has some education or training contributing toward a stronger work ethic than other farmers with lower status (Rosaiah, 2002; Mary, 2004).

Further, with higher social status, social participation, information seeking behaviour, innovativeness, economic motivation and scientific orientation, a farmer can have access to more labor to help farming, or have access to surplus income to adopt newer technologies (Johnson, 2002; Jayalakshmi, 2004). For these reasons, it is necessary to construct a scale in order to know how profile characteristics affect a farmer's ability to adopt sustainable practices.

MATERIALS AND METHODS

Study site

Puducherry located on the Coramandal coast 11° 52' N, 79° 45' E and 11° 59' N and between 79° 52' E covers an area of 480 sq km. The study area experiences mean annual temperature of 30.0°C and mean annual rainfall about 1311 to 1172 mm. The mean number of annual rainy days is 55, the mean monthly temperature ranges from 21.3 to 30.2°C. The climate is tropical dissymmetric with the bulk of the rainfall during northeast monsoon October to December (Indian Meteorological Department - Chennai).

Selection of respondents

Bahour is one of the seven communes of Pondicherry regions and it is located near the river bank/basin of Pennaiyar River, this region comprises of agricultural lands which are more suitable and convenient (soil texture) for groundnut and vegetable cultivation (Figure 1). Almost all the agricultural lands suffered highly due to the ill effects of Green Revolution Agriculture (GRA) like salinization of aquifers, polluted/degraded the soil, air and water quality, loss of diversity of beneficial biota are noted (Babou et al., 2009). This resulted in declined production, so some innovative farmers diverted into their old past traditional sustainable organic farming techniques in order to overcome these effects of GRA (Bockstaller et al., 1997; Dore et al., 2007). Two sets of respondents that is, GRA/Organic farmers, about 50 persons in each category were randomly selected from the village by Participatory Farm Management method, Questioners and Interviews (Kerlinger, 1964). The results are statistically analyzed by using the software SPSS 16.

Adoption level of sustainable farming practices

Rogers and Shoemaker (1971) defined adoption as a decision to continue full use of an innovation. In this study, adoption meant following sustainable farming practices. The rate of adoption of sustainable farming practices by the farmers was measured by means of an adoption index developed by Karthikeyan (1994) using the following formula.

$$\text{Adoption index} = \frac{\text{Respondents total score}}{\text{Total possible score}} \times 100$$

Where,
Respondents total score = Total number of practices adopted by a farmer / multiplied by the respective practice weight age and summated.
Total possible score = Total number of practices recommended, multiplied by the respective practice weight age and summated.

Using the cumulative frequency method, the rate of adoption by respondents were classified into low, medium and high based on adoption index value.

Estimation of benefit-cost ratio (BCR) of SA and GRA practices

The benefit- cost ratio measures the returns or benefits per unit cost of investment. Benefit-cost ratio is operationalised as the ratio between total cost of production and total receipts realized by the respondents on practicing sustainable farming.

A schedule was prepared with regard to cost of cultivation for major crops cultivated by farmers in the study area for three years 2007 to 2008, 2008 to 2009 and 2009 to 2010. The schedule consisted of package of practices requiring inputs, expenditures and net benefits for all three years.

RESULTS

Majority of the organic farmers were middle aged, had education varying from primary to collegiate level, primarily involved in agricultural occupation, majority of the farmers possessed small level of farm size, had high level of farming experience with medium level of experience in sustainable farming, belonged to high income group, possessed high level of livestock, exhibited medium level of social participation, high level of information seeking behaviour, innovativeness, economic motivation, scientific and risk orientation. 73% had attended more than one training session and 27% had attended training once in sustainable farming and they had medium level of market perception.

Majority of the GRA farmers belonged to middle age category, primary to collegiate level, primarily involved in agricultural and other occupations, possessed marginal level of farm size, had medium farming experience, belonged to low and medium income group, possessed medium level of livestock, exhibited medium level of social participation, information seeking behavior and innovativeness, high level of economic motivation, scientific orientation and risk orientation. Majority had not attended any training related to sustainable farming and had medium level of market perception.

Sustainable farming practices wise adoption and percentage level among organic farmers is clearly represented in Table 1. Sustainable practices like energy conservation, water conservation, soil health and nutrient management, bio-diversity management, pest and disease management and health management (Goldsmith and Hildeyard, 1996; Hansen et al., 2006) are taken into consideration. Various reasons for non-adoption of sustainable farming practices (different criteria's) by GRA farmers are clearly stated at percentage level in Table 2.

Productivity and Income generation

The yield and income generation in the organic farming found to be increased year by year after their conversion and decrease in production in inorganic fields year to year (Figure 2). Yields and profit in the organic systems were 28 to 32% higher than those in the conventional plots mainly due to manually prepared organic fertilizers and their time being application. There are significant difference between the farming systems in environment production, biodiversity, food quality, production and soil quality. Organic farming was less expensive, efficient and sustainable, which conserves the environment and that improves socio-economic status of the farmers (Babou et al., 2009).

Estimation of benefit-cost ratio (BCR) of organic and GRA practices

The benefit-cost ratio worked out for organic and inorganic management. It could be observed that B:C ratio was higher in organic farms (Figure 3). Thus, because the organic farmers replaced the external inputs by farm derived resources normally leads to reduction in variable input costs under sustainable management. Expenditure on fertilizers and pesticides were substantially lower than inorganic management in almost all the cases. Costs of inputs were reduced in organic farming because of adoption of indigenous techniques like composting, bio-pesticides, use of natural predators and parasites, growth promoters like effective micro-organisms and Panchakavya, as a consequence crop growth and yield were enhanced and increased, resulting in increased farm income.

DISCUSSION

In practice wise, full rate of adoption was seen only in

Table 1. Adoption level of sustainable farming practices by organic farmers. n = 50.

S. No	Practices	Adoption (%)	
		Adopted	Non-adopted
	Energy conservation measures		
1.	Use of renewable energy measures	54	46
2.	Converted farm and household energy utilizing units to more energy efficient alternatives	20	80
	Water management		
1.	Minimum water use on the farm i.e. by recycling, conserving, and/or collecting water and/or using low demand systems.	67	33
2.	Water use minimized further by planting water-conserving varieties and/or ground covers.	80	20
	Soil fertility management		
1.	Manures and nutrients are applied when it is necessary	100	0
2.	Nutrient management is based on soil tests every 1-3 years and recommended application rates not exceeded by more than 10%.	80	20
3.	Application strategy relies almost exclusively on precision application techniques.	80	20
	Soil health management		
a)	**Soil organic matter**		
1.	A strong effort is made to maximize and maintain soil organic matter through a) restricted tillage practices, b) cover crops, c) crop rotations, or d) use of manures or composts on fields.	100	0
2.	Use of inorganic fertilizer is completely or almost completely eliminated.	100	0
b)	**Use of cover crops and vegetative areas**		
1.	Bare soil on the farm is kept to a minimum via vegetative plantings, buffer strips, pasture, other perennial crops and seasonal crops.	100	0
2.	Cover crop type and timing are strategically chosen, based on farm characteristics such as soil type and traditional crop grown, to maximize benefits to soil.	80	20
c)	**Crop rotation**		
1.	Crop rotations are specifically planned to optimize nutrient and pest control.	80	20
2.	Crops are rotated at least once in every three years.	100	0
d)	**Tillage practices**		
1.	An effort is made to minimize/alter tillage use to benefit soil quality.	60	40
2.	Conservation tillage is used to maintain crop residue on soil	60	40
3.	Perennial crop system is used, allowing for a no-till farming operation.	54	46
e)	**Soil conservation/erosion prevention**		
1.	At least one step has been taken to minimize erosion, such as utilizing diversion ditches, maintaining vegetated buffer strips around bodies of water, using conservation tillage or creating windbreaks, mulches are used, manure or composts incorporated into fields, perennial crops are used on farm.	80	20
f)	**Soil quality monitoring**		
1.	Soil quality is measured via soil tests every 1-3 years and farm practices strictly follow.	80	20

Table 1 Cont'd.

	Biodiversity management		
a)	**Diversity of crops and other allied enterprises**		
1.	Use of more than one variety within the crop	80	20
2.	Adoption of integrated farming systems	80	20
b)	**Agroforestry**		
1.	Selection of suitable agroforestry programmes.	80	20
2.	Selection of species based on soil types, utility, income generated and resource availability.	100	0
3.	Use of improved planting and moisture conservation techniques.	80	20
	Pest and disease management		
a)	**Pest management**		
1.	Pest identification and scouting information are always used to manage pests and beneficial organisms.	20	80
2.	Use of eco-friendly traditional pest control methods	87	13
3.	When a control measure is needed, every effort is made to use beneficial organisms or cultural controls, using reduced toxicity pesticides as a last resort.	80	20
4.	Only bio pesticide application is made at first sign of pests.	87	13
5.	Pesticide applications are made only when pests reach a predetermined treatment threshold.	87	13
b)	**Disease management**		
1.	Disease identification is always used to manage plant diseases.	80	20
2.	Use of eco-friendly traditional disease control methods	80	20
3.	Only bio pesticide application is made at first sign of diseases.	87	13
	Weed management		
1.	Plan and manage ground cover or soil to prevent weeds and weed seed immigration.	80	20
2.	Plant crops using a precision system, which allows for precise mechanical, weed removal.	54	46
3	When a control measure is needed, every effort is made to use cultural methods of weed control.	80	20

Table 2. Specific reasons/causes for the non-adoption of sustainable farming practices by GRA farmers. n = 50.

S. No	Reasons for non-adoption	Major reason	Somewhat a reason	Not at all a reason
	Physical causes	**%**	**%**	**%**
1.	Timely non-availability of inputs 1) Seeds at time 2) Bio fertilizers 3) Bio control agents 4) Eco-friendly plant protection chemicals.	20	13	67
2.	Poor quality of inputs	13	20	67
3.	Timely non-availability of labor	7	13	80
	Extension activity			
1	Lack of training	40	40	20
2	Lack of technical guidance	40	47	13
3	Non-availability of extension service	27	33	40
4	Venue of training place too far	27	33	40

Table 2 Cont'd.

	Communication			
1	Lack of information about sustainable farming	67	20	13
2	Lack of social participation	60	27	13
3	Poor access towards extension agency	47	20	33
	Personal			
1	Illiteracy	0	0	100
2	Tradition	0	0	100
3	Aversion towards use of SA waste and manure	0	0	100
4	Unaware about importance of sustainable farming	67	26	7
5	Lack of knowledge and skill	80	13	7
6	Lack of competition and experience	67	26	7
7	Lack of interest	80	13	7
	Economy causes			
1	High cost of inputs	47	20	33
2	Inadequate credit facilities	53	27	20
3	Complex loaning procedure	60	13	27
4	High rate of interest	27	27	54
5	High wages to labor	53	27	20
6	High risk and uncertainty of return	80	13	7
7	Crop yield is low	80	20	0
	Market causes			
1	Undesirable price for the produce	53	20	27
2	Lack of good transport facilities	40	20	40
3	High transport cost	33	27	40
4	No separate marketing channel	14	20	66

following techniques like Azolla cultivation, preparation and application of the following innovative sustainable organic farming practices as mentioned by Padmavathy and Poyyamoli (2011). Preparation of Panchagavya (organic liquid fertilizer), Amirtha karaisal, Meein amilam (organic urea), Flower stimulating solution, bio-insecticide and Vanamutham (EMO-effective micro organisms). This is mainly due to the economic constrains and education status of the farmers (Smitha, 2004; Saravanapriya, 2005). Sustainability assessments of the farms are considered as a key principle for the determination of the stability of the social, economic and ecological frame work and farmers risk awareness and risk management measures. The overall results are summarized and displayed in the sustainability polygon (Figure 4). Among the farms, SA farm recorded positive values of sustainability indicators. While in GRA farms are under stress and registered the negative values.

Reasons for non-adoption of sustainable farming practices

Among the specific causes, non-availability of labour, lack of interest in practicing SA due to high wages to labour, high perceived risk and uncertainty of return, no separate marketing channel for the produce were considered as major reasons for non-adoption of sustainable farming practices by GRA farmers.

Strategies to popularize sustainable/organic farming

1) Contract farming and export of concern commodity.
2) Large-scale production of biofertilizers, bio-insecticides and biopesticides.
3) Encouragement and support from government.
4. Awareness campaigns, Training camps and popularization of sustainable/organic farming.
5) Training programs with demonstrations about biofertilizers, biopesticide and different composts production.
6) Establishment of extension services by governments collaborative engagement with NGOs.
7) Special insurance scheme for sustainable farms that reduces the risk of farmers in case of failure of crop should be implemented.
8) Establishment of separate marketing channel for

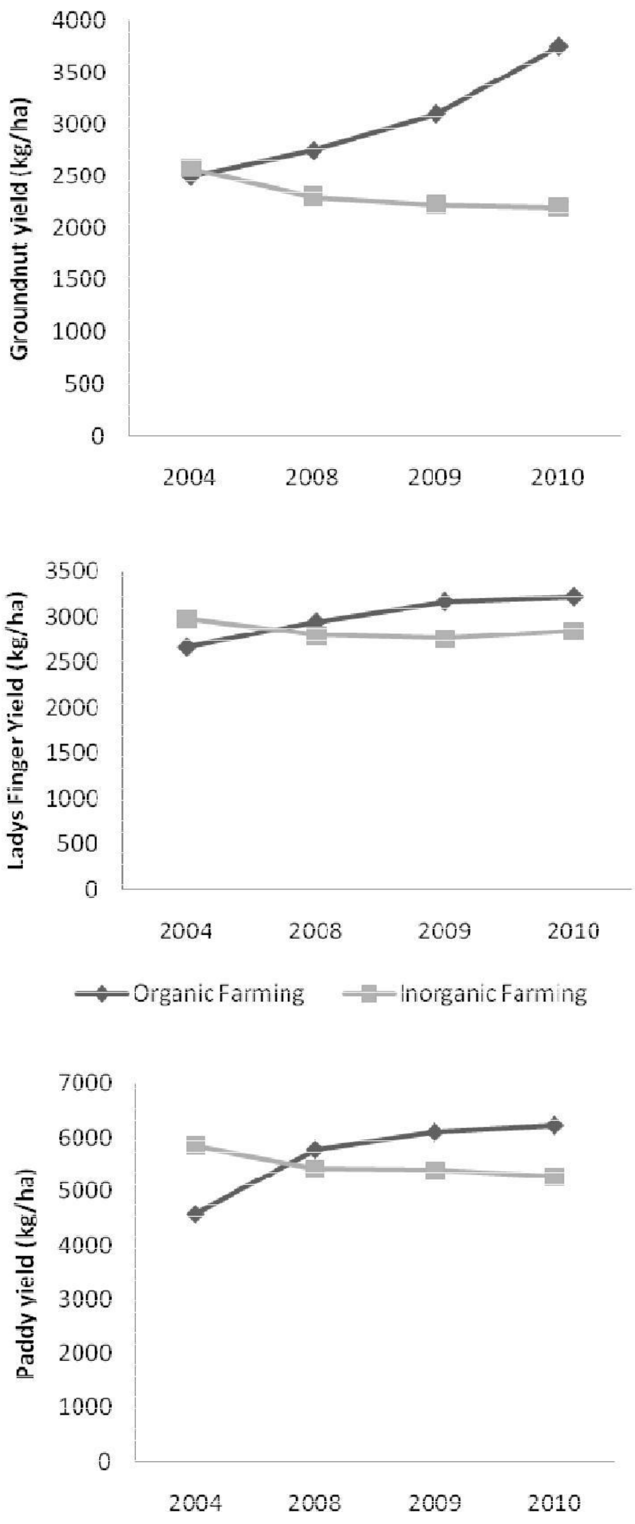

Figure 2. Yield of paddy, groundnut, and ladys finger in the farming systems in the organic and inorganic farming systems.

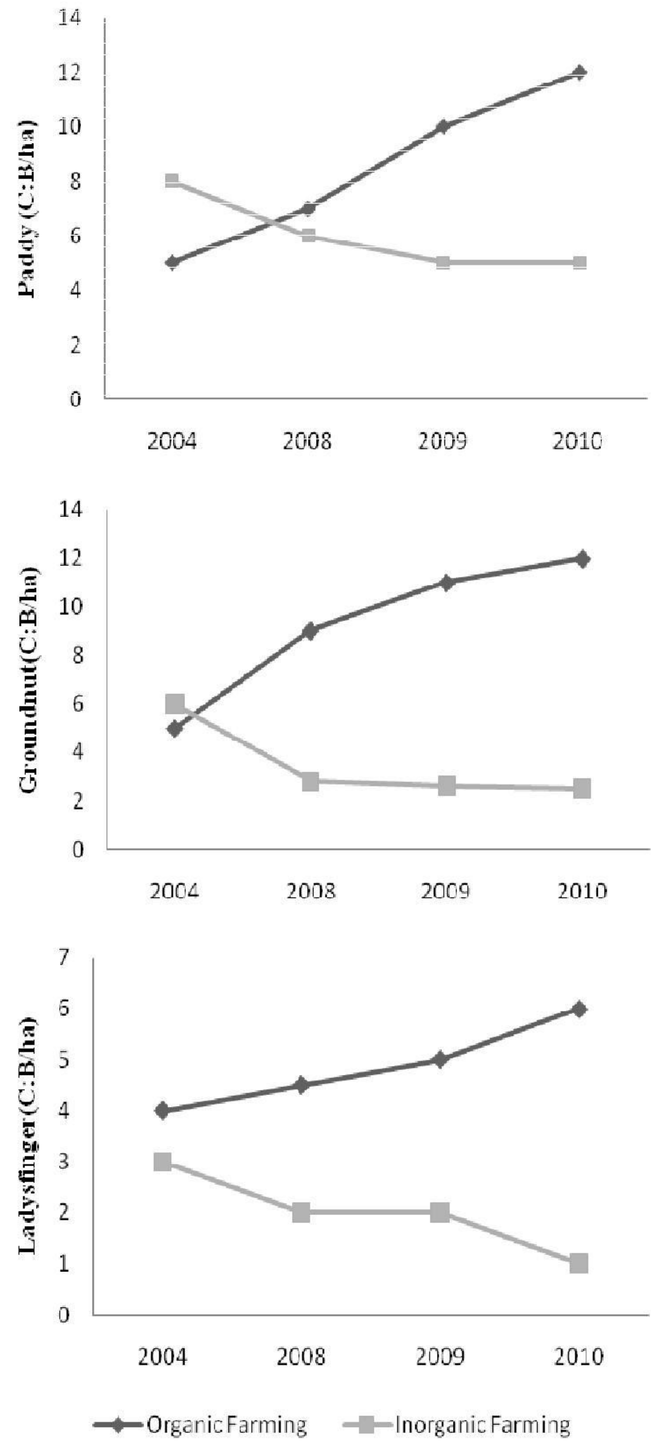

Figure 3. C:B ratio from paddy, groundnut, and ladys finger production in the organic and inorganic farming systems.

organic products.

9) Establishment of Agricultural Export Zones in the potential areas.

Conclusion

Based on the aforementioned findings, we conclude that sustainable organic farming practices significantly enhance the sustainability of the environment, farms and livelihood of the farmers but certain constrains diminished

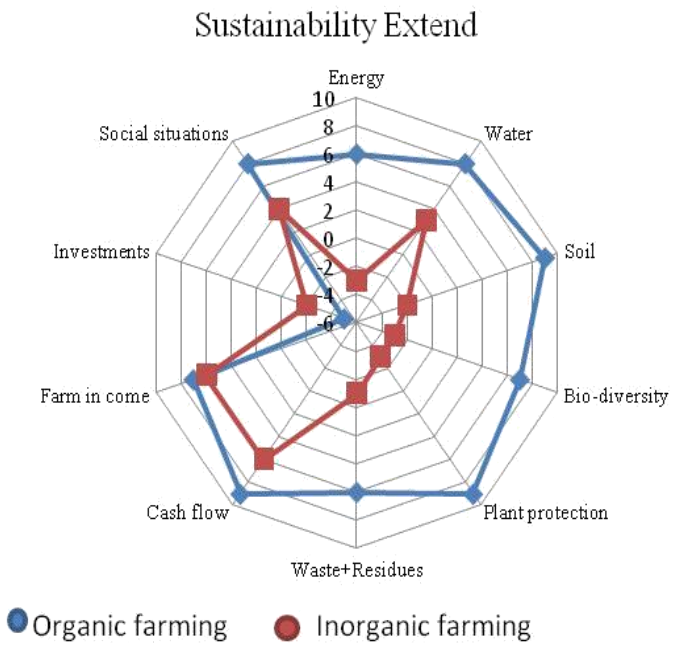

Figure 4. Sustainability extend between the GRA and organic farms.

the adoption of sustainable organic agricultural practices. However, this can be overcome by adopting the previously discussed strategies. By doing this, we can possibility overcome the ill effects of GRA, conserve various agroecosystem services, prevent environment degradation, farmers can have stable economic status and sufficient stable quality/quantity of the products (Uphoff and Altieri, 1999; Badgley et al., 2007; LaSalle et al., 2008).

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