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International Journal of Current Research
Vol. 5, Issue, 10, pp.3221-3227, October, 2013

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

EXTENT OF SUSTAINABLE FARM PRACTICES IN PADDY CULTIVATION OF CAUVERY DELTA IN TAMIL NADU

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ARTICLE INFO

Article History:
Received 15th July, 2013
Received in revised form
06th August, 2013
Accepted 19th September, 2013
Published online 23rd October, 2013

Key words:

Sustainable Agriculture,
Sustainable Farming Practices,
Organic inputs,
Chemical inputs,
Awareness.

ABSTRACT

Sustaining the productivity of natural resources is most important issue in the 21st century. There is an urgent need for proper distribution, efficient utilization, better management and proper development of natural resources. They are addressed with the view of fulfilling the ever-growing demand for food, fodder and fiber and fuel by both present and future generation. Sustainable Agriculture is a loosely defined term that comprises a range of strategies for addressing many of the problems that affect agriculture world-wide. These problems include the loss of soil productivity by intensive cultivation and allowing soil erosion; pollution of surface and ground water by extensive use of pesticides and fertilizer; diminishing supplies of non-renewable resources by over extraction; diminishing the quality of renewable resources by unmindful waste generation and discharge; increase in global warming by changing crop pattern; and so on. The technological transfer drive of which, one part forms the yielding wonder seeds, the other parts of the process are application of fertilizer and pesticides, improved water supplies, following intensive and extensive cropping, better cultural practices, etc. The environmental cost is outweighing the net development benefits level and thus sustainable development of natural capital starts to move in negative direction. Specific objectives of the study: i) to find out to what extent the farmers of the study area are practicing sustainable paddy cultivation in the Cauvery delta ii) to analyze the factors contributing the present level of sustainable farm practices and iii) to examine the impacts of sustainable practices on the farm income. This study uses both primary and secondary data. Primary data collected from the select households of the study village, who follow sustainable farm practices, after getting ideas from various sources and secondary data are collected from the different government offices at block level and from published and unpublished sources.

INTRODUCTION

Agriculture has changed drastically at global level since the end of World War II. In India, the style of agricultural production has changed largely after the Green Revolution (1965). Food and fiber productivity has reached new peaks due to adoption of new technologies, implementation of mechanization, increased chemical use, following crop specialization, and changes in government policies that favored maximization of production. However, these changes are not uniform for all regions and all crops. Continuous changes also bring in many negative impacts. Crop yields remaining stagnant, pesticides polluting the eco-systems, increasing cost of fertilizers, reducing soil fertility, reducing both the surface and the ground water quality, imbalance in host-parasite and predator-parasite relationships have pushed agriculture into a dangerous mode, making the surface water competitive, pushing down the ground water level at an alarming rate, and so on. Scientists have looked back into the technologies evolved and used to increase the crop yields. Long term projections have indicated that agriculture is pushing itself towards stagnation with severe damage to eco-systems due to heavy use of chemical inputs and unsustainable farm practices. Steadily growing public concerns about pesticides, food safety, environmental quality, groundwater contamination, dependency on finite supplies of fossil fuels and soil and water conservation have led many growers and researchers to consider alternative means of agricultural production - generally labeled sustainable agriculture. Practices commonly associated with sustainable management include, reduced use of chemicals and fossil fuels, maximum use of on-farm inputs, crop nutrient recycling, and increased use of diversified crop rotations that enhance soil cover and fertility.

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Brief Review of Literature

There are many studies available worldwide on sustainable agriculture. Some of illustrative studies are given below: sustainable agriculture helps farmers and it survives for a very long period because it works with nature (Norman *et al*., 1997). Sustainable agriculture reduces the cost of purchased

inputs by utilizing farming techniques that incorporate biological cycles and the farmers' knowledge and skills (Norman *et al*., 1997; Pretty and Hine 2001). It also helps small farms to continue operating through diversification and increased profits from alternative ways of production and marketing - such as niche markets, value added products, or direct marketing strategies (Local Harvest 2005; Horrigan *et al*., 2002). Mstudies (Bonny, 2001; Rajanna, *et al*., 2009) observe that the sustainable organic farming practices significantly enhance the sustainability of the environment, farms and livelihood of the farmers but certain constraints diminished the adoption of sustainable organic agricultural practices. Above studies indicate the importance of sustainable agriculture and their benefits in short. Most studies suggest the way in which the sustainable agriculture is extended. Farmers should be motivated to rectify the imbalances and look for sustainable practices, eco-friendly practices which can maintain the soil fertility intact and at the same time increase productivity. The practices which support the use of low cost input will sufficiently increase profit of the farming and income of agricultural sector.

Sustainable Agriculture

In recent years a concept of sustainable agriculture is developed in order to ensure that the agro-eco-systems are stabilized and sustained crop yields are assured on long term basis. It is important to understand the elements of sustainable agriculture. In a broader sense, sustainable agriculture involves practices such as organic farming, biological and natural control of pests, and emphasis of watershed approach to conserve the soil and water, build up of micro-flora in close harmony with beneficial soil-inhabitants and complete desisting of the use of synthetic chemicals. It ensures pollution free food production and ensures continuation of agriculture with least damage to eco-system. In short, sustainable agriculture refers to agriculture - where the agro-eco-systems function on self sustaining basis for nutrient supply and crop protection in order to stabilize the crop yields. FAO (1992) defined sustainable agriculture and rural development, at the Earth Summit in Rio de Janeiro, as "the management and conservation of the natural resource base and the orientation of technological and institutional change in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations. Such sustainable development (in the agriculture, forestry, and fisheries sectors) conserves land, water, plant and animal genetic resources, is environmentally non-degrading, technically appropriate, economically viable and socially acceptable". Later, FAO (1995) redefined the sustainable agriculture and rural development on the basis of its process criteria as, "ensures that the basic nutritional requirements of present and future generations, qualitatively and quantitatively, are met while providing a number of other agricultural products; provides durable employment, sufficient income, and decent living and working conditions, for all those engaged in agricultural production; Maintains and, where possible, enhances the productive capacity of the natural resource base as a whole, and the regenerative capacity of renewable resources, without disrupting the functioning of basic ecological cycles and natural balances, destroying the socio-cultural attributes of rural communities, or causing contamination of the environment; and reduces the vulnerability of the agricultural sector to adverse natural and socio-economic factors and other risks, strengthens and self-reliance".

Sustainable Farm Practices

Although sustainable agriculture does not refer to a standard set of agricultural practices, there are certain methods or practices that enhance sustainability (Horrigan *et al*., 2002). Such methods are regarded as sustainable agricultural practices. There is a wide array of sustainable agriculture practices that are being employed by farmers. Some of the most commonly mentioned in the literature are crop rotation, cover crops, no-till and low-till farming, soil conservation, diversity, nutrient management, integrated pest management, rotational grazing, water quality/wetlands, agro-forestry, and alternative marketing (SARE 2002; Horrigan *et al*., 2002). The present sustainable agricultural farm practices indicate the farm practices which reduce use of natural inputs such as water; limiting the use of seeds, selection of pest resistant crop varieties; reduced use of chemical inputs like various fertilizer, pesticides, weedicide and fungicide; application of natural inputs like farmyard manure, green manure, and biofertilizer; practices that used to conserve water and soil, allowing and facilitating (as bio-control measure) natural enemies against the pests, rats, etc. Despite the great promise of sustainable agriculture in helping to alleviate the problems originated from industrial agriculture, adoption of sustainable practices remains low in many parts of the world. Pretty and Hine (2001) analyzed data from Africa, Asia and Latin America and concluded that from the total agricultural land only a 3 percent is under some type of sustainable agriculture practice. So, it is important to study the extent to which farmers use sustainable farm practices, how they differ in implementation of such practices according to land size group and suggest measure to expand such practices to get desirable impact.

Objectives of the study

Present study has the following specific objectives: i**)** To find out to what extent the farmers of the study area are practicing sustainable paddy cultivation in Cauvery delta, ii) to analyse the factors contributing to the present level of sustainable farm practices iii) to examine the impacts of sustainable practices on the farm income, and iv) to provide suitable suggestions to speed up the sustainable farm production.

MATERIALS AND METHOD

Cauvery Delta zone is regarded as the rice bowl of Tamilnadu, which is one among the many advanced agricultural states in India. This delta area caters to the food needs of the state. Majority of the agricultural lands are used for paddy cultivation, which is the staple food crop of south India. The study area has good natural inputs – soil, water, climate and specialized agricultural labourers. River Cauvery and its branches provides water potential and soil fertility to this area since very long time. Thanjavur - occupying major portion of the delta - is one among the pioneering districts in which Green Revolution was introduced in 1965. Cauvery delta is the lifeline of Tamilnadu state. Fluctuations in production of paddy bring about many impacts in the state's economy. Price of rice fluctuated in the tune area under paddy cultivation in the delta. Paddy is cultivated mainly in two seasons ie.

kuruvai (June – September) and *thaladi/samba* (September/October – January/February) and marginally in summer (February – May) season. Above said facts indicate the importance of paddy cultivation in resource endowed Cauvery delta region. To understand the levels of sustainable farm practices implemented by the farmers, factors influencing it and impact of such practices on income of the farms are essential. Present study is conducted among the selected sample farmers of *Pasupathi Kovil* of *Papanasam taluk* in *Thanjavur district* of *Tamilnadu.*

Survey for the study has been conducted among randomly selected 112 paddy producing farmers belonging to different land owning groups during period between July and October, 2010. Sample farms are classified on the basis of size of land holding as *marginal* (holding up to 2.50 acres), *small* (2.51 – 5.00 acres), *medium* (5.01 – 10.00 acres) and *large* (10.01 acres and above). The study is based on both primary and secondary data. Primary data have been collected with the help of interview schedule. Important primary data collected for the study are land holding particulars, cropping pattern, sustainable farm practices for paddy cultivation, levels of awareness on sustainable agriculture, etc. Secondary data have been collected from the district administrative office, village administrative offices, and agricultural offices at village and district levels. Further, relevant materials from journals and books are also used for the study. Statistical analysis Data collected from the above said sources are analysed with the help of simple statistical tools like averages, percentages and standard deviation.

RESULTS AND DISCUSSION

Following section of the paper provides analysis and discussion made on the primary data collected through the field survey. As reported earlier, the study covered 112 sample farmers from a select village in the Cauvery delta. Before going to main analysis it is important to study the background of the respondents, farm size groups, and nature and type of land ownership of the sample farms. Gender and farm size are considered as important variable in determination of type of farm practices. Table 1 furnishes the details on gender of the respondents and land size-group of sample farmers.

Table 1. Distribution of the Respondents according to Farm Size and Gender

Gender of Respondents	Marginal Farms	Small Farms	Medium Farms	Large Farms	All Farms
Male	24	14	10	10	58
	(52)	(37)	(55)	(100)	(52)
Female	22	24	8	-	54
	(48)	(63)	(45)		(48)
Total	46	38	18	10	112
	(100)	(100)	(100)	(100)	(100)
	[41]	[34]	[16]	[9]	[100]

Source: Field Survey

Notes: Figures in ( ) indicate percentages to column total; and figures in [ ] indicate percentages to row total. These notes are common for all the subsequent tables.

The above table shows that the distribution of sample respondents according to sex and farm size groups. As stated in the beginning of the analysis, totally 112 farmers are covered under the study, in which more than half of them are female respondents. This is highly unusual in such a type of agrarian studies. Most female members of the village underwent training on sustainable farm practices than the male members. Female members acquire knowledge on sustainable farm practices either through agricultural offices, Tamilnadu Women in Agriculture (TANWA) programme, non-governmental organizations (as formal training) or from co-members of self-help groups - who already attained knowledge in any on the of the above sources. The study village, *Pasupathi Kovil*, is the first village in which women self-help-group model was introduced in Thanjavur district. These factors caused more representation of sample from women side. However, women representation is not uniform for all the farm size groups. Only there is a week representation of women in the case of medium farm group and no single representation from large farm group. Land holding particulars of the sample households are presented in Table 2.

Table: 2 Land particulars of the sample households (Acres in average)

Land Particulars	Small Farms	Small Farms	Medium Farms	Large Farms	All Farms
Own Land:					
Wet	1.64	2.75	6.00	5.00	3.13
Garden	0.48	0.61	0.98	1.60	0.69
Total	2.12	3.36	6.98	6.60	3.82
	(94.20)	(89.40)	(72.30)	(50.00)	(75.00)
Leased-in land:					
Wet	0.17	0.61	3.33	6.60	1.48
	(7.50)	(16.20)	(34.00)	(50.0)	(29.10)
Leased-out Land:					
Wet	0.04	0.21	0.66	0.00	0.21
	(4.80)	(5.60)	(6.80)	(0.00)	(4.10)
Total operational Holding:					
Wet	1.77	3.15	10.17	11.16	4.40
Garden	4.80	0.61	0.98	16.00	0.69
Total	2.25	3.76	9.65	13.20	5.09
	[100]	[100]	[100]	[100]	[100]

Source: Field Survey

Note: Total Operational holding: [Own land + Leased in Land] – Leased Out Land].

Irrespective of the farm size group, all have own land. However, the proportion of own land to the total operational holding varies according to farm size. All farmers' average size of operation holding is calculated as 5.09 acres, in which 75 percent is own land and 29 percent is leased-in land. But, farmers leased-out only 4 percent of the land to others. Average size of operational holding for different farm size group varies from 2.25 acres for marginal group to 13.20 acres for large group. The proportion of own land to total holding is negatively associated with farm size. This ratio ranges from 50 percent in the case of large farm group to 94 per cent in the case of marginal group. We can state this in another way that the proportion of leased-in land to the total operational holding is positively associated with the farm size. This proportion varies from just 8 for marginal group to 50 for large group. Size of leased-out land is very smaller for all the groups and it varies within a narrow band between 0.04 acre for marginal group and 0.66 acre for medium group. No farmers from large group have leased-out their land to others.

Paddy Cultivation in Different Seasons

Paddy is a seasonal crop. Farmers cultivate this crop generally more than once in a year in the Cauvery delta region. Majority of the farmers of this study village cultivate *kuruvai*, a first

season paddy crop. But, all farmers cultivate *thaladi* (as a second crop in *kuruvai* cultivated land) and/or *samba* (as a single paddy crop for a whole year by omitting *kuruvai*) season. The period of cultivation of thaladi and samba falls more or less in a similar period. And, only few farmers, who have adequate ground water extraction facilities, cultivate paddy crop in summer. All-farmers average paddy area cultivated during the *kuruvai* season is 2.65 acres. But, this highly varies from just 0.58 acre for marginal group to 9.20 acres for large group. The proportion of area under paddy cultivation to the total operational area is nearly 90 percent in the case of large farmers. However, this proportion is about only 20 percent in the case of marginal farmers. There is a positive association between proportion of paddy area cultivated and the size of operational holding, during this season. As stated earlier, all farmers cultivate paddy during *thaladi* and/or *samba* season. The proportion of operational holding brought under the paddy cultivation ranges between 50 percent in the case of marginal farmers to 95 percent for large farmers. Irrespective of the farm groups, the percentage of land brought under paddy cultivation is higher in this season than *kuruvai* and *summer* seasons (Table 3).

Table 3. Details on Paddy Cultivation

Season Cultivation	Marginal Farms	Small Farms	Medium Farms	Large Farms	All Farms
Kuruvai					
No. of producers	18	36	18	10	82
Extent cultivated (area)	0.58	1.86	5.33	9.20	2.65
Production (qtls)	9.70	29.14	39.02	159.6	44.39
value(Rs)	6,234	15,659	59,141	56,250	21,900
Thaladi /samba					
No. of producers	44	38	18	10	110
Extent cultivated (area)	1.03	2.64	6.78	10.40	3.44
production(qtls)	18.16	49.99	119.69	204.96	62.38
value(Rs)	10497	24689	54766	80640	260291
Summer season					
No. of producers	-	-	4	10	14
Extent cultivated (area)	-	-	1.11	8	1.30
Production(qtly)	-	-	11.33	130.80	20.
Value(Rs)	-	-	13500	56250	9964
All season					
Extent cultivated (area)	1.61	4.60	13.22	27.60	7.04
production(qtls)	29.86	72.07	219.73	495.36	119.10
value(Rs)	16,644	41,655	1,09,441	3,29,616	38530

Source: Field Survey

Different Sustainable Farm Practices

Sustainable farm practices of the farmers are viewed and analysed in three different stages: basic sustainable farm practices; practices at the time of nursery preparation; and, practices after the transplantation but before harvesting of paddy crop in the main field. Table 4 provides information on basic sustainable farm practices like following regular crop rotation (for balancing soil nutrient), soil testing (for limiting the use of fertilizer and apply only required type and quantity of fertilizer), summer plough and advance land preparation (both the measure used to hold water holding capacity of soil and control weeds). 104 out of 112 farmers are following crop rotation in their farms. Mostly all farmers from marginal, small and medium groups are regularly practicing crop rotation at least in part of their land holdings. But, only 4 out of the 10 farmers alone in the large group practice crop rotation in their farm. It should be noted that farmers of this group are cultivating paddy in all three seasons intensively and there is less scope for crop rotation. Soil testing is important factor for rational application of nutrients to the soil. Nearly 83 percent of the farmers are doing regular soil test. Soil testing behavior is very poor in the case of farmers of marginal group. But, more or less all the farmers belong to small, medium and large groups are practicing soil testing. Summer plough is essential to hold rain water in the soil and also for pest control. It is also important to control weed in the fields. As in the cases of soil test, a considerable number of small farmers do not plough their field during summer. But, small and medium farmers are usually doing such practices. 6 out of 10 large farmers do not follow this system, since throughout the year they are cultivating paddy and there is no chance for summer plough. Advance and adequate land preparation is essential to minimize resources need and also to minimize the crop losses by pests and rats. Unexpectedly, this behavior is commonly poor for all the farms, irrespective of different land-size owning groups.

Table 4: Basic Sustainable Farm Practices

Practices	Marginal Farms	Small Farms	Medium Farms	Large Farms	All Farms
Crop rotation	44	38	18	4	104
Soil test	30	38	16	10	94
Summer plough	34	38	16	4	92
Advanced land preparation	6	8	2	6	22

Source: Field Survey.

Sustainable Farm Practices in Paddy Nursery

Table 5 provides information on input used for preparing paddy nursery by different size group of farmers (inputs uses are standardized to nursery prepared to plant one acre). Important inputs reported here are land, seeds, application of farm yard manure (FYM), application of bio-fertilizer and application of chemical fertilizer. On the average, farmers are using 8.93 cents of land to prepare nursery. There is no much variation in using the land for nursery preparation among the different farm groups. However, the extent of area used for nursery goes positively with the size of farms. Like that, seed requirement is also positively related to the size of the farm. It

varies narrowly between 44.67 kgs. for marginal farms to 46.80 kgs. for large farms. Application of farm yard manure to nursery field has a strong and positive association with farm size. It varies from 1.39 cart-loads for marginal farms to 2.40 cart-loads for large farms. In the same manner application of bio fertilizer (varies from 3.30 kgs. to 6.40 kgs. respective of farm size groups) and chemical fertilizer (7.13 kgs. for marginal farms 11.33 kgs. for medium farms) also has positive relationship with the farm size. Application of chemical fertilizer for nursery by the large group farms is somewhat lower than its immediate previous group.

Table 5. Level of input used for Nursery meant for per acre of Paddy Cultivation

Inputs used in Nursery	Marginal Farms	Small Farms	Medium Farms	Large Farms	All Farms
Land (in cents/acre)	8.56	8.86	9.22	9.20	8.93
Seed (in kgs.)	44.67	46.93	46.67	46.80	46.09
FYM (in cart load)	1.39	2.14	2.77	2.40	1.98
Bio fertilizer (in kgs.)	3.30	6.92	5.78	6.40	5.27
Chemical fertilizer (in kgs.)	7.13	8.43	11.33	8.60	6.12

Source: Field Survey

Sustainable Farm Practices in Main Paddy Field

Table 6 indicates the details on basal application of farm yard and green manure to the main paddy field by the sample farmers of the study village. Application of farm yard manure is mainly carried out for the *kuruvai* paddy. It is not convenient to apply farm yard manure for *thaladi/samba* or for summer paddy, since carrying the manure through wet field is difficult. So, the information on application of farm yard manure means application for *kuruvai* paddy alone. Number of card loads of farm manure applied (as basal) for acre of paddy field varies from 9.60 for large farmers to 12.21 for small farmers.

Table 6. Basal application of the Organic Manure to Main Fields

Type of Manure	Marginal Farms	Small Farms	Medium Farms	Large Farms	All Farms
FYM					
No. of Farms	42	38	18	10	108
Average application (in cart load)	10.61	12.21	10.78	9.60	11.25
Compost					
No. of Farms	6	2	2	-	10
Average quantity (cart load)	3.43	3.00	2.89	6.80	3.50
Green manure					
No. of farms	24	28	10	4	66
Average quantity (kgs.)	18.5	12.33	12.50	10.00	14.50

Source: Field Survey
Note: Average cost cart load (= kgs. 400) is Rs 300.

Generally, farmers apply compost to a limited extent alone. Only 8 out of 112 farmers apply it for their farms. Almost all the farmers are applying available green leaf manure to their farm. They have collected green leaf from the trees around the boundaries of field and nearby places at free of cost. 110 out of 112 farmers are using green leaf for the *kuruvai* paddy crop. The average utilization of green leaf manure varies from 2.89 cart-loads for medium farmers to 6.80 cart-loads for large farmers. The rate of application of green manure is high in the case of large farm group. Only around 50 percent of farmers of each group apply packed green manure to their farm. Its quantity of application largely varies between 10.0 kgs., for large farms and 18.5 kgs, for marginal farms. Farmers apply chemical fertilizer like urea, DAP, nitrogen and potashes, two or three times during the cultivation of paddy crop. Details on basal application of chemical fertilizer are provided in Table 7.

Table 7. Basal Application of Chemical Fertilizer

Chemical Fertilizer	Marginal Farms	Small Farms	Medium Farms	Large Farms	All Farms
All fertilizer (in kgs.)	90.17	106.43	111.78	96.00	98.48
Value	685	775	838	730	739

Source: Field Survey.

From the tables it is understood that the quantity of application of urea and DAP varies from 90.17 kgs. for marginal farm group to 111.78 kgs., for medium farm group. Large farmers apply somewhat lesser quantity than the other groups. However, they use these fertilizers even lower than the overall average of all farmers (which is 98.48 kgs).

Top Dressing of Chemical Fertilizer

Farmers are widely using fertilizer of nitrogen and potash varieties as top dressing for paddy field in all the three seasons. The average quantity of nitrogen fertilizer used directly varies with farm size and it ranges between 53.48 kgs., for marginal farmers to 69.00 kgs., for large farmers. In the same manner, the application of potash fertilizers varies widely with farm size. The average quantity of application of this fertilizer varies from 33 kgs., for marginal farmers to 62 kgs., for large farmers (refer Table 8). Ongoing analysis shows that use of chemical fertilizer use is relatively more in larger size farms. It can be inferred alternatively that small farmers reduce the use of chemical fertilizer.

Table 8. Details on Top Dressing of Chemical Fertilizer

Fertilizer (in kgs.)	Marginal	Small	Medium	Large	All
N	53.48	53.64	62.33	69.00	52.20
K	33.26	46.14	60.67	62.00	43.70
Total Value (Rs.)	666.50	821.08	1039.69	1089	785.4

Source: Field survey.

Utilization of Bio-fertilizer

Farmers are using bio fertilizer like azospirillum, blue green algae, azola, and PAZ in their paddy fields. Actual rate of application by the sample farmers per acre is presented in Table 9.

Table 9. Utilizations of Bio-Fertilizers

Bio fertilizer (in kgs.)	Marginal	Small	Medium	Large	All
Azospirillum	1.46	1.76	1.73	1.40	1.62
Blue green Algae	1.07	0.80	1.40	1.00	1.10
Azola	0.5	0.30	-	-	0.43
PAZ	0.8	0.8	-	-	0.8
Total (qty./ kgs)	2.31	1.99	2.2	2.4	2.72
Value (in Rs.)	142	100	122	132	152

Source: Field survey.

The all-farmers average of utilization of azospirillum is 1.62 kgs, and it varies from 1.40 kgs., for large farmers to 1.76 kgs., for small farmers. The average utilization of blue green algae is around 1 kg, it is more or less the same for all farmers.

Azola, one of the bio-fertilizers, is used less than half a kg. by both the marginal and the small farm groups and none of the medium and large farmers use this fertilizer in their farm. PAZ is used less than one kg.

Application of Chemical Pesticides

Farmers use varieties of pesticides both in liquid and dust form. Details on application of chemical pesticides are presented in Table 10. The rate of application is not similar for all farm groups. It varies from 300 grams in the case of small farmers to 1000 grams for both medium and large groups. In terms of value, it varies from Rs.160 for marginal farmers to Rs.450 for medium and large farm groups.

Table 10. Details on Pesticides Utilization

Particulars	Marginal	Small	Medium	Large	All
No. of farmers using pesticides	16	2	2	6	26
Average quantity (in ml.)	356	300	1000	1000	550
Value (in Rs)	160	135	450	450	247.50

Source: Field survey.

Awareness of the Farmers on different Sustainable Farm Practices

It is important to assess the awareness attained by farmers' through sustainable farm practices. Generally, one can expect that there is a positive association between level of awareness and actual attitude.

Table 11. Level of Awareness on Sustainable Farm Practices

Awareness on Practices	Marginal Farms	Small Farms	Medium Farms	Large Farms	All Farms
a) Crop rotation	3.60	4.10	4.20	5.00	4.10
b) Leaving the land as fallow	3.00	3.90	3.90	4.80	3.80
c) Summer plough	3.00	3.90	4.70	5.00	4.20
d) Advanced land preparation work	3.70	4.50	3.80	4.40	3.60
e) Tradition seed varieties	3.80	4.40	4.30	5.00	4.20
f) Pest resistant varieties	3.70	4.40	4.60	4.40	4.10
g)Direct sowing	3.20	3.80	4.10	5.00	3.70
h) Water management	3.50	4.40	4.40	4.40	4.00
i) Organic manure	3.60	4.60	4.70	5.00	4.20
j) Soil test	3.40	4.50	4.70	5.00	4.10
k) Eco-friendly, Pest, Weed and Rat Control	3.80	4.50	4.60	5.00	4.30
l) Pesticides and Chemicals usage	3.80	4.60	4.40	5.00	4.30
m) Natural eco system	3.70	4.60	4.70	5.00	4.30
n) Favorable-eco system	3.80	4.60	4.70	5.00	4.30

Source: Field Survey.
Note: Scores up to 1.0 Very Poor; between 1.1 and 2.0 Poor; 2.1 and 3 Average; 3.1 and 4 Good; and 4.1 and 5 Excellent.

But, ground level realities may differ with general expectation. In order to verify this, observations made on level of awareness obtained by farmers who may apply lower level of practices due to various problems faced by the farmers of particular locality. When the problems are solved then they will increase the practices to a maximum extent. So, assessment of awareness is essential to improve level of practices. From Table 11 it is clear that level of awareness regarding various sustainable farm practices is either good or excellent for most farmers. However, the level of awareness is relatively poor for marginal and small farm groups, and it is relatively high for medium and large groups. But, through the analysis it is understood that marginal and small farmers are practicing relatively more level of sustainable farm practices than the medium and large farm groups. Paddy farmers use various types of organic and inorganic inputs in farming. However, there are inter-group differences appearing in the use of above said inputs in paddy cultivation. Marginal and small farm groups move in favour of various organic inputs than the medium and large farm groups. Farm size, season of paddy cultivation, availability of organic input from the own sources and cropping and irrigation intensity are the major determinants of implementing level of sustainable farm practices. Farmers of marginal and small land owning groups incur relatively lesser cost of production by means of using more proportion of organic input and lesser level of inorganic inputs. These indirectly indicate that the net income from paddy cultivation is higher for marginal and small farm groups than the other two higher land groups. Even though the farmers of larger and medium groups have higher level of awareness on sustainable farm practices, practically they are implementing lesser level due to non-availability of adequate quantum of organic inputs from the own sources, higher irrigation and cropping intensity, etc.

Conclusion

Over the centuries, farming systems that were once mutually beneficial to people, animals and the environment have transformed into intensive farming systems that are destroying rural livelihoods and increasing urban migration and poverty, by means of increasing cost of cultivation, reducing availability of quality natural inputs, etc. Approximately, 75 per cent of the world's poor live in rural areas; the majority depends on agriculture. Even though there is a declining trend in the share of agriculture sector to the national income, it effectively acts as a livelihood to our country. Indian agriculture sector has several liabilities to the country. It should provide food and fiber to the people of the country which has world's (second) largest population; it should provide fodder to the country which has largest cattle population; it should continuously provide employment and purchasing power to the people of the country in which more than 70 percent people are living in the rural area; and, it should continuously support the country in which significant amount of foreign exchange is earned through net external agricultural trade. This sector has a closer contact with all the natural resources for its production activities, than any other sector. So, the effective and speedy implementation of sustainable farm practices will ensure the country's development as sustained one. In turn, this will help to protect the interest of both present and future generations.

REFERENCES

Bonny, Binoo P. and K. Vijayaragavan. 2001. "Adoption of Sustainable Agriculture Practices by Traditional Rice Growers". Journal of Tropical Agriculture. 39: 151-156.

FAO (1992):www.fao.org/docrepw7541E/W7541eo4.htm

FAO (1995):www.fao.org/wssd/sard/index-en.htm

Horrigan, Leo, Robert S. Lawrence, and Polly Walker. 2002. "How Sustainable Agriculture Can Address the Environmental and Human Health Harms of Industrial

Agriculture." *Environmental Health Perspectives.* 110 (5):445-456.

Local Harvest. 2005. "Family Farms". Retrieved September 1, 2005, Local Harvest website (http://www.localharvest.org/ organic-farms).

Norman, David, Rhonda Janke, Stan Freyenberger, Bryan Schurle, and Hans Kok. 1997. "Defining and Implementing Sustainable Agriculture." *Kansas Sustainable Agriculture Series*, 1:1-14. (www.kansassustainableag.org/Pubs_ksaac/ ksas1.htm).

Pretty, Jules, and Rachel Hine. 2001. "Reducing food poverty with sustainable agriculture: A summary of new evidence." Centre for Environment and Society, University of Essex, Colchester, UK. (www2.essex.ac.uk/ces/Research/ Programmes/ SAFEWexecsummfinalreport.htm).

Rajanna N., K. G. Vijayalaxmi, M. T. Lakshminaryan and N. Chandregowda "Attitude of Paddy Farmers towards Sustainable Farming Practices" Mysore Journal agriculture science, 43(3), 2009, 522-526.

Sustainable Agriculture Research and Education (SARE). 2002. "Exploring Sustainability in Agriculture." Retrieved August 15, 2005, Sustainable Agriculture Research and Education Program website (http://www.sare.org/ publications/sexplore/index.htm).

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