J. Fac. Appl. Biol. Sci.,
Hiroshima Univ.(1998), **37** :39~52

Farm Techniques Used by the Japanese Farmers in Achieving Sustainable Agricultural Development

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Received March 10, 1998

Abstract The study focuses on the farm techniques (FTs) used by the Japanese farmers in the cultivation of rice, vegetables and flowers, and fruits in order to attain sustainable agricultural development. Data were collected from a random sample of 45 households through personal interview schedule by the Co-operative Supervisors during 15 September to 10 November 1997. In addition, data were also collected from the extension officials and co-operative advisors through RRA (Rapid Rural Appraisal) during July to December 1997. Four-point Likert type scale was used to measure the farm techniques used by the farmers. Farm techniques use index (FTUI) was also computed in order to make ranking of the techniques used. The findings reveal that farmers' use of farm techniques were the highest in rice cultivation followed by vegetables and flowers, and fruits respectively. The use of farm techniques by the farmers had significant positive correlation with their farm size, and contact with information sources.

Key words: Farm techniques, farmer, sustainability, agriculture, environment.

1. Introduction

Agriculture in Japan plays an important role in people's lives in that it not only supplies food essential to everyday life but also provides a rich life filled with greenery and recreational space through conservation of national lands and the environment (MAFF, 1995). Although rice covers more than three-quarters of the total cultivated land in Japan and its productivity is one of the highest in the world (Kashem and Mikuni, 1998), the Japanese farmers have increasingly concentrated on the production of fruits, vegetables, and livestock, while the production of rice, wheat, barley, soybeans, and potatoes has decreased (CUAC, 1993). Such divergent trends are attributed to changes if food consumption and the unfavorable impacts of imports. Reflecting these circumstances, Japan's self-sufficiency in grains fell from 82 per cent in 1960 to 30 percent in 1989 (*Ibid*). Area of cultivated land in Japan has decreased by 15 per cent in the last three decades (1960 through 1991) and agricultural land given up cultivation is increasing remarkably (Mukai, 1995:28). That is the result of industrial adjustment on the course of international specialization, and none can be blamed for this. Actually, about 66 per cent land demand for urban use (factories, dwellings, roads and so on) has been met by transformation of agricultural land (*Ibid*: 29). Decreasing of cultivated area is substitut-

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ed by increasing of food imports. Cereal imports by Japan has increased by 6.3 times in the last three decades (1960 through 1991) and now Japan is the biggest importer of food in the world, and has the lowest self-sufficiency rate of cereals among developed countries except demographically small countries (*Ibid*).

Rice is the major crop in Japan. Although the use of fertilizers and agricultural chemicals in Japan has a stagnant trend after 1980, but it still is on a high level: on an average 30 kgs of fertilizers and 15 kgs of agricultural chemicals (dust and granules) per 0.1 hectare are used in rice farming by the Japanese farmers (*Ibid*: 32). This is, of course, a very high rate of using fertilizers and agricultural chemicals compared to international standards. Sometimes farmers also use fertilizers and agro-chemicals in over doses although there are no reported cases where farmers used these chemicals below the optimum doses. Especially when fertilizers and agro-chemicals are indiscriminately used that causes a threat to environment vis-a-vis human life. It leads to residual effect in food, pollution to soil, water and air. The use of agro-chemicals especially insecticides, fungicides, weedicides, and rodenticides produced various problems including resistant strains. Many insects, diseases and weeds have developed their own mechanisms to survive unless pesticides are sprayed in over doses. But over doses lead not only to kill and destroy the harmful insects, weeds , rather it kills many beneficial insects, and other soil micro-organisms followed by many other related complexities. There are instances that skin diseases among children have now become more common in Japan than before. It may be quite likely that due to the residual effects of pesticides many other diseases are now in existence. None the less, the small fishes in the rivers and canals, frogs, earthworms and other soil micro-organism population are decreasing remarkably, if not already extinct. All these factors have now led some farmers in Japan to go for re-invention, the degree to which an innovation / technology is changed or modified by a user in the process of its adoption and implementation (Rogers, 1995:17), and organic farming in order to expedite the process of sustainable agricultural development. Organic farming is a kind of farming agriculture that uses no pesticides and chemical fertilizers, based on using organic manures, green manures and composts for continuous recycling of the process of soil fertility and productivity. There is no doubt that organic farming has the potential to provide benefits in terms of environmental protection, conservation of non-renewable resources, improved food quality, reduction in output of surplus products and the reorientation of agriculture towards areas of market demand (Lampkin and Padel, 1994:3). Considering the importance of farmers' own innovative ideas and modification of existing technologies as well as farmers' use of organic farming the present study was undertaken with the following specific objectives:

1. To describe some selected personal, economic, social, and psychological profiles of the farmers.
2. To determine the extent of use of farm techniques by the farmers towards achieving sustainable agricultural development.
3. To explore the relationships of the selected personal, economic, social, and psychological profile of the farmers with their use of farm techniques.

2. Methodology

2.1 Collection of Data

Data for this study were collected in two phases : (i) interviewing farmers, and (ii) interviewing extension officials (Director, Deputy Director, Chief, Subject Matter Specialists, and Extension Officers) of the Co-operative Agricultural Extension Service, and Co-operative Advisers of the Japan Agricultural Co-operatives through RRA (Rapid Rural Appraisal). Data from the farmers were collected from 45 randomly selected households (out of 560) during 15 September to 10 November 1997 through personal interview schedules by the Co-operative Supervisors. On the other hand data from the extension officials and co-operative advisers were collected during June to December 1997.

2.2 Measurement of the Variables

Farmers' personal, economic, social, and psychological profiles constitute the independent variables of the study whereas the use of farm techniques constituted the dependent variable. The variables were measured as follows:

1. Age: Age of the farmers were recorded on the basis of their chronological years from their date of births to the time of interviewing.

2.Family size: This was defined as the number of persons who were considered as the family members at the time of interview and it was measured on the basis of actual numbers.

3. Family education: This was measured on the basis of the education of the family members including the respondent himself. The score for individual category was multiplied by the number of persons included in that category as follows:

Category	Score	Number of persons	Total score
Passed elementary school	1	_____	_____
Passed Junior High School	2	_____	_____
Passed Senior High School	3	_____	_____
Passed graduation	4	_____	_____
Passed post-graduation	5	_____	_____
	Round total		_____

4. Farm size: This was measured on the basis of individuals's land under cultivation, either own land or tenanted land. The respondents were asked to indicate their amount of land under cultivation in local units called *are* (100 *are* is equivalent to 1 hectare). However, all types of local units of land measurements were converted to hectares for analysis and discussion.

5. Socio-economic status(SES): This was defined as the individual's position and status in the society. It was measured by one's possession of land, types and quality of houses, annual income, farm power and implements, household furniture etc. The total SES scores were calculated by adding all the sub-scores as follows:

a) Land:

Categories	*weight*
----- up to 50 are	1
----- 51a ~ 100 are	2
----- 101 ~ 150 are	3
----- 151 ~ 200 are	4
----- 201 ~ 300 are	5
----- more than 300 ares	6

b) % income from agriculture:

category	*weight*
----- up to 10%	1
----- 10.1 ~ 30%	2
----- 30.1% ~ 50	3
----- 50.1% ~ 70%	4
----- more than 70%	5

c) Annual income:

category	*weight*
----- Yen up to 300,0000	1
----- Yen up to 400,0000	2
----- Yen up to 500,0000	3
----- Yen up to 600,0000	4
----- Yen up to 700,0000	5
----- Yen above 700,0000	6

d) Farm power and implements:

category	*weight*
----- Automatic cultivator	1
----- Auto rice planter	2
----- Tractor	3
----- Combined harvester	4
----- Truck	5
----- Rice Polisher/hulling machine	6
----- Rice flavour machine	7
----- Glass house	8
----- Cold storage	9

e) Material possession:

category	*weight*
----- Bi-cycle	1
----- Motor cycle	2
----- Television	3
----- Car	4
----- Washing machine	5
----- Refrigerator	6
----- Air cooler	7
----- Computer	8

Overall SES = a+b+c+d+e =

6.Contact with information sources (CIS): This was measured on the basis of farmers' contact with the three major aspects of communication, such as, (a) personal localite, (b) personal cosmopolite, and (c) mass media. A four point Likert type scale was developed and used to measure the variable. The respondents were asked to indicate whether they had contacts either *most often, moderate, little, or not at all* with a score of 3, 2, 1 and 0 respectively for 16 predetermined information sources. The possible CIS could for each respondent could range from 0 to 48, 0 indicating no contact and 48 very high contact.

7. Participation in social organization (PSO): This was measured on the basis of farmers' participation in different organizations either as ordinary member or executive committee member with a weightage of 1 and 2 respectively. The farmers were also asked to indicate whether their participation was *regular, often,* or *never* in the organization where they were affiliated with a weight of 2, 1, and 0 respectively. In order to get an individual's total scores in PSO his initial score for primary membership was multiplied by the frequency of his participation in organizations. In all there were ten organizations. Thus the possible PSO scores for an individual in Bangladesh could vary from 0 to 40.

8. Perception about benefits of using organic farming: A five point Likert type scale was used to measure this variable. The respondents were asked against 10 statements on the benefits of using organic farming to indicate whether they *strongly agreed, agreed, disagreed, strongly disagreed,* or *had no opinion* with a corresponding weightage of 4, 3, 2, 1, and 0 respectively. Thus the perception of benefits of using organic farming scores of each respondent could range from 0 to 40.

9. Attitude towards the use of organic farming: This was measured by using a five point Likert type scale. In all there were eight statements, four positive and four negative, on different aspects of organic farming. The respondents were asked to express their degree of agreement against each of the statements by indicating whether they *strongly agreed, agreed, disagreed,* or *strongly disagreed* with a corresponding weightage of 4, 3, 2, and 1 for the positive statements and the reverse for the negative statements respectively. However, in both the cases the respondents having *no opinion* on the statements got a score of zero. Thus, the possible attitude towards the use of organic farming scores of the respondents could vary from 0 to 32.

10. Use of farm techniques (FTs): There were 43 statements on the use of re-invented farm techniques on various aspects of rice, vegetables and flowers, and fruits in respect of their production, protection, and preservation towards achieving sustainable agricultural development. Farmers were asked to express their extent of use of farm techniques by indicating whether their use was *very much, moderate, little,* or *not at all.* A weight of 3, 2, 1, and 0 was assigned to *very much, moderate, little,* and *not at all* responses respectively. Thus, the use of farm techniques scores of the farmers could vary from 0 to 129.

In order to identify the important re-invented farm techniques (FTs) a farm techniques use index (FTUI) was computed. The FTUI for each statement was calculated by using the following formula:

$$FTUI = N_1 X 3 + N_2 X 2 + N_3 X 1 + N_4 X 0$$

where,

FTUI= Re-invented farm techniques use index

N_1 = Number of farmers whose use of FTs was very much

N_2 = Number of farmers whose use of FTs was moderate

N_3 = Number of farmers whose use of FTs was little

N_4 = Number of farmers who did use the FTs not at all

The FTUI for each of the statements on the farm techniques could thus vary from 0 to 135. On the basis of the FTUIs the FT statements were ranked for ease of discussion.

3. Empirical Findings

3.1 Findings on the Farmers' Interviewing

The salient features and basic statistical values of the selected personal, economic, social, and psychological profiles of the farmers are presented in Table 3.1. The findings in respect of the use of re-invented farm techniques are presented in Table 3.2.

Table 3.1 Salient features and basic statistical values of the farmers

Independent and dependent variables	Values			
	Min.	Max.	Mean	SD
1.Age (years)	28	83	52.71	13.58
2.Family size (absolute number)	2	9	4.84	1.53
3.Family education (rated scores)	2	21	12.38	4.38
4.Farm size (hectare)	0.45	3.60	1.17	0.62
5.Socio-economic status (rated scores)	35	72	55.64	7.42
6.Contact with information sources (rated scores)	3	30	13.60	6.92
7.Participation in social organizations (rated scores)	0	13	5.89	3.33
8.Perception of the benefits of using organic farming (rated scores)	0	32	22.49	8.11
9.Attitudes towards the use of organic farming (rated scores)	0	26	15.80	6.42
10.Use of farm techniques (FTs) (rated scores)	0	61	16.60	12.21

Table 3.2 Use of farm techniques (FTs) by the farmers (N=45)

Sl. Nr.	Farm techniques (FTs)	Extent of use				FTUI	Rank Order
		Very much	Much	Little	Not at all		
	a. Rice						
1.	Use of manure at the base during transplanting wet land paddy for better utilization of manure.	4 (8.9)	3 (6.7)	10 (22.2)	28 (62.2)	28	7
2.	Using mixture doses of rapid and slow responsive fertilizers in order to prolong the span of effectiveness.	0	3 (6.7)	4 (8.9)	38 (84.4)	10	9
3.	Using of good quality composts to improve the soil condition.	2 (4.4)	12 (26.7)	15 (33.3)	16 (35.6)	45	3
4.	Improving the management of insecticides and fertilizers based on field diagnosis.	4 (8.9)	6 (13.3)	22 (48.9)	13 (28.9)	46	2
5.	Use of crop rotation for maintaining soil fertility.	1 (2.2)	5 (11.1)	13 (28.9)	26 (57.8)	26	8
6.	Using run-off waters from the hills by placing isles.	2 (4.4)	11 (24.4)	12 (26.7)	20 (44.5)	40	4

7.	Using dust and granular pesticides if broadcasted.	0	7 (15.6)	15 (33.3)	23 (51.1)	29	6
8.	For economic use of pesticides binding of sprayers with the transplanters.	0	2 (4.4)	0	43 (95.6)	4	11
9.	Use of pesticide box for seedling in order avoid environmental hazards and stabilize effect.	7 (15.5)	14 (31.1)	12 (26.7)	12 (26.7)	61	1
10.	Use of polythene mulch for controlling weeds, pests and stabilize effect of fertilizers.	0	2 (4.4)	3 (6.7)	40 (88.9)	7	10
11.	Transplanting cultivation of wet paddy in non-cultivated land: omitting cultivation and upturning field.	0	0	3 (6.7)	42 (93.3)	3	12
12.	Broadcasting cultivation of wet paddy in noncultivated land: cultivating paddy by broadcasting seeds directly in lotus marsh.	0	0	1 (2.2)	44 (97.8)	1	14
13.	Mixed cultivation of different crops for expanding seasonal span and prevent insect and disease infestation as well as proper use of labour.	3 (6.7)	8 (17.8)	14 (31.1)	20 (44.4)	39	5
14.	Use of resistant varieties: cultivation of mixed culture by multi-line varieties.	0	0	2 (4.4)	43 (95.6)	2	13
15.	Use of recycling papers in paddy fields for controlling weeds.	0	0	1 (2.2)	44 (97.8)	1	14
16.	Paddy farming with ducks to control weeds and diseases and to add manures to soil by its feces.	0	1 (2.2)	0	44 (97.8)	2	13
	b. Vegetables and Flowers						
1.	Avoiding the damage from drought and flood as well as raise utility of machinery by creating irrigation and drainage system.	0	4 (8.9)	15 (33.3)	26 (57.8)	23	6
2.	Establishing long term crop rotation scheme in order to prevent the infestation of pests.	0	2 (4.5)	19 (42.2)	24 (53.3)	23	6
3.	Use of composts (organic fertilizers) by well linked with livestock farmers.	1 (2.2)	6 (13.3)	13 (28.9)	25 (55.6)	28	5
4.	Maintaining soil fertility and productivity by changing horticultural crops by paddy in turns.	0	1 (2.2)	8 (17.8)	36 (80.0)	10	11
5.	Ploughing deeply every couple of years for maintaining soil fertility along with rotatory cultivation such as sorghum wheat or rai wheat.	0	4 (8.9)	9 (20.0)	32 (71.1)	17	8
6.	Using traditional cultivation history of soil and growth for better technology management.	0	5 (11.1)	9 (20.0)	31 (68.9)	19	7
7.	Establishing a standard input of manures and fertilizers by using slow effect fertilizers only.	1 (2.2)	7 (15.6)	15 (33.3)	22 (48.9)	32	3
8.	Intercropping Mary gold, Guinea grass, and Hubues to control the diseases of Senchu from the damage of nematode.	0	1 (2.2)	5 (11.1)	39 (86.7)	7	14

9.	Using pheromone insecticide which is less hazardous to environment to reduce damage due to pests.	1 (2.2)	1 (2.2)	3 (6.7)	40 (88.9)	8	13
10.	Developing technology based on the test of nutrition.	0	0	7 (15.6)	38 (84.4)	7	14
11.	Preventing insect and disease infestation which is brought by scraps of animals feed.	1 (2.2)	1 (2.2)	4 (8.9)	39 (86.7)	9	12
12.	Controlling the outbreak of causative bacteria when upturning soil or using foreign soil.	1 (2.2)	3 (6.7)	24 (53.3)	17 (37.8)	33	2
13.	Use of resistant varieties to Yellow Disease, Black Rotten disease and Root Rotten Disease.	0	1 (2.2)	9 (20.0)	35 (77.8)	11	10
14.	Effective use of mulching materials.	3 (6.7)	9 (20.0)	14 (31.1)	19 (42.2)	41	1
15.	Simplicity of shipment of seeds to maintain seed quality by decreasing the use of insecticides.	2 (4.4)	7 (15.6)	12 (26.7)	24 (53.3)	32	3
16.	Use of repellent insects to control pests instead of using pesticides.	0	1 (2.2)	1 (2.2)	43 (95.6)	3	15
17.	Intercropping repellent plants (such as Mary gold and Peanut) to control green pests.	0	1 (2.2)	9 (20.0)	35 (77.8)	11	10
18.	Use of repellent seeds and plants for preventing pests and diseases.	0	3 (6.7)	8 (17.8)	34 (75.5)	14	9
19.	Better management of vegetable residues for preventing diseases.	2 (4.5)	5 (11.1)	14 (31.1)	24 (53.3)	30	4
	c. Fruits						
1.	Use of green leaves and manures for increasing soil fertility.	0	4 (8.9)	8 (17.8)	33 (73.3)	16	1
2.	Application and use of Pheromone in apple cultivation.	0	0	2 (4.4)	43 (95.6)	2	6
3.	Use of repellent insects to control pests in apple cultivation.	0	0	2 (4.4)	43 (95.6)	2	6
4.	Use of protective Bacillus sp. for resisting melasma (Black spot) and white spots diseases in pears and grapes cultivation.	0	0	2 (4.4)	43 (95.6)	2	6
5.	Decreasing use of agro-chemicals through improving management practices.	1 (2.2)	0	7 (15.6)	37 (82.2)	10	3
6.	Using repellent insects, micro-organisms, and plants as the primary way, or using less toxic agro-chemicals as the sub-way to establish a general control system.	0	1 (2.2)	1 (2.2)	43 (95.6)	3	5
7.	Developing new varieties through cross breeding with disease resistant varieties.	0	1 (2.2)	2 (4.5)	42 (93.3)	4	4
8.	Using paper bags to cover fruits for protecting from insect pests and diseases as well as to decrease the use of agro-chemicals.	2 (4.4)	1 (2.2)	3 (6.7)	39 (86.7)	11	2

(N.B.: Figures within parentheses indicate percentages of the respondents)

The findings reveal that among 16 farm techniques in respect of rice crop the top five in descending order were: (i) use of pesticide box for seedling in order to avoid environmental hazards and to maintain stability, (ii) using fertilizers on the basis of field diagnosis for better fertilizer management, (iii) using fertilizers at the base of the plants for increasing effectiveness, (iv) using run-off waters from the hills by placing isles, and (v) mixed cultivation of different varieties for expanding seasonal span and prevent insect and disease infestation as well as proper use of labour. Out of 19 FTs on vegetables and flowers the top five were: (i) effective use of mulching materials, (ii) using soil management practices to control causative bacteria, (iii) using manures and slow responsive fertilizers, (iv) better management of vegetable residues for preventing diseases, and (v) use of organic fertilizers. However, out of eight FTs on fruit cultivation the top three were: (i) use of green leaves and manures for increasing soil fertility, (ii) using paper bags to cover fruits for protecting from insect pests and diseases as well as to decrease the use of agro-chemicals, and (iii) decreasing agro-chemicals through management practices. The technologies re-invented and used by the farmers may be considered by the administrators and policy makers for incorporating them in farmers' training programmes so that other farmers can get exposure of these techniques and derive desired benefits out of these.

In order to explore the relationships between different independent variables as well as relationships of independent variables with the dependent variables Pearson product moment correlation coefficients were computed by using the microstat computer software. The findings are presented in Table 3.3. The findings show that the use of farm techniques by the farmers had significant positive

Table 3.3 Interrelations among the independent and dependent variables (N=45)

Variables	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	Y
X_1	1.000									
X_2	- 0.442**	1.000								
X_3	- 0.335*	0.495***	1.000							
X_4	- 0.234	0.008	- 0.027	1.000						
X_5	0.131	- 0.009	0.195	0.141	1.000					
X_6	- 0.135	- 0.117	- 0.068	0.290	- 0.021	1.000				
X_7	0.066	- 0.168	- 0.167	- 0.024	0.208	0.061	1.000			
X_8	- 0.014	0.112	0.213	0.064	- 0.170	0.230	- 0.380**	1.000		
X_9	0.177	0.017	0.138	- 0.237	- 0.070	- 0.049	- 0.314*	0.643***	1.000	
Y	- 0.254	- 0.050	- 0.145	0.324*	- 0.117	0.582***	0.114	0.017	- 0.241	1.000

* Significant at $p < 0.05$ level; ** Significant at $p < 0.01$ level; *** Significant at $p < 0.001$ level

Variables code:

X_1 = Age
X_2 = Family size
X_3 = Family education
X_4 = Farm size
X_5 = Socio-economic status
X_6 = Contact with information sources
X_7 = Participation in social organizations
X_8 = Perception about benefits of using organic farming
X_9 = Attitude towards the use of organic farming
Y = Use of farm techniques (FTs)

correlations with their (i) farm size, and (ii) contact with information sources. In respect of the findings on inter-correlations among different independent variables the findings reveal that age of the farmers had significant negative correlations with family size and family education; family size had significant positive correlation with family education; participation in social organization had significant negative correlations with perception about benefits of organic farming , and attitude towards the use of organic farming; and perception about benefits of using organic farming had significant positive correlation with attitude towards the use of organic farming.

The findings demonstrate that size of farms as well as farmers' contact with information sources are the predictors of their uses of farm techniques. As already stated that the area of cultivated land in Japan has decreased by 15 per cent from 1960 to 1991 and as such farm size by households are also expected to decreasing due to land transfer to successive generations. Hence, nothing specially can be done in respect of increasing the use of farm techniques with the increase of farm size of the farmers. However, there is an ample scope to increase the use of farm techniques by increasing farmers' contact with information sources. The more the contact of the farmers with the information sources the more would be their use of farm techniques. The present findings also showed (which has not been included in this paper) that farmers had the highest contact with co-operative supervisors followed by newspapers, opinion leaders, neighbours, and extension officers. Farmers' use of radio, television, and farm publication was not satisfactory although from the Co-operative Agricultural Extension Service as well as Japan Agricultural Co- operatives many messages are designed and published as farm publications for farmers, and many of those information are arranged to deliver from the radio and television. May be the content of the farm publications, and timing and messages delivered through radio and television are not appropriate with farmers' needs, interests, timing and preferences. That is why the use of these media is not satisfactory among farmers. The concerned administrators and policy makers should think over the matter and take necessary steps to increase the use of these media by the farmers.

3.2 Results of Interviewing with Extension Officials and Co-operative Advisers

Several discussions were held with the extension officials, and cooperative advisors and supervisors. Among extension officials discussions were held with the following persons:

(i) Director, and Deputy Director of RAI &EC (Regional Agricultural Improvement And Extension Center), Hiroshima Prefecture.

(ii) Chief and Deputy Chief of Agricultural Extension Center, Higashi-Hiroshima, Hiroshima Prefecture

(iii) Director of Agriculture Department, Hiroshima Prefectural Government.

(iv) Director, and Agricultural Cooperatives Supervisor, Prefectural Unions of Agricultural Cooperatives, Higashi-Hiroshima, Hiroshima Prefecture

(v) President, Prefectural Unions of Agricultural Cooperatives, Hiroshima Prefecture.

From the series of discussion it was found that there are many farmers who are now interested in using farm techniques and organic farming; some farmers even are continuing to disvover new tech-

niques for sustainability in agriculture. Especially the popularity for (i) integrated rice-cum-duck farming, (ii) organic farming, and (iii) mechanical ways of controlling insect pests is increasing steadily. In integrated rice-cum-duck farming no agro-chemicals are used in rice fields. This method is being practised in at least 15 hectares of paddy rice fields in Hiroshima Prefecture of Japan. On a national basis a total of 2000 households were recorded in 1994 who were practicing this method and a "National Duck-assisted Paddy Rice Society" has been formed with initial members of 500 (JICA, 1994). As a part of organic farming farmers use organic manures, green manures, and composts in growing rice, vegetables and fruits. In order to emphasize this campaign a "Japan Society for the Study of Organic Farming" has been established in 1971. But the success of this campaign is still limited; only a small percentage of farmers now use this practice on regular basis. Of course, there are practical problems in using this method. For example, although consumer demand for organic food products is increasing gradually but as yet there are no national standard: these are still decided by the individual producers (OECD, 1993:62). By personal initiatives some organic farmers have by this time been established in Japan.

There are some farmers in Japan who mechanically control the insect pests unless the use of insecticides are indispensable. Especially fruit gardeners make this practice. For example, the peach farmers usually wrap and tie the peaches by especially designed paper in order to protect the fruits from the attack of insect pests at the one hand and to keep the fruits in good colour and flavour on the other. Moreover, some farmers use chilly (peeper) powder to control insect pests.

4. Conclusion and Recommendations

1. The most important farm techniques used by the farmers in achieving sustainable agricultural development came out as an outcome of the present study include the following:

Rice:

(i) use of pesticide box for seedling in order to avoid environmental hazards and to maintain stability,

(ii) using fertilizers on the basis of field diagnosis for better fertilizer management,

(iii) using fertilizers at the base of the plants for increasing effectiveness,

(iv) using run-off waters from the hills by placing isles, and

(v) mixed cultivation of different varieties for expanding seasonal span and prevent insect and disease infestation as well as proper use of labour.

Vegetables and flowers:

(i) effective use of mulching materials,

(ii) using soil management practices to control causative bacteria,

(iii) use of manures and slow responsive fertilizers,

(iv) better management of vegetable residues for preventing diseases, and

(v) use of organic fertilizers.

Fruits:

(i) use of green leaves and manures for increasing soil fertility,

(ii) using paper bags to cover fruits for protecting from insect pests and diseases as well as to decrease the use of agro-chemicals, and

(iii) decreasing agro-chemicals through management practices.

These technologies may be selected as the issues of discussion in the training sessions for the farmers. In order to arouse farmers' interest low cost leaflets, booklets, and bulletins may be prepared on these aspects to distribute among farmers. Arranging field trips and tours for the farmers to see practically the use of these farm techniques as and when possible during training session may greatly help in understanding the practical benefits of using these farm techniques.

2. Contact of the farmers with information sources had significant positive correlation with their use of farm techniques. As it was found that farmers' use of radio, television, and farm publications was minimum as a contact media it is necessary to rethink and re-orient the messages delivered in these media. These media need to be more information oriented so that farmers perceive these as useful media for improving their agriculture especially in respect of sustainability issues.

3. The integrated rice-cum-duck farming in Japan is increasingly becoming popular. Especially this technique is spreading rapidly to other countries and much interest has now been aroused in Korea, China, and Taiwan. Some 10,000 families have by this time adopted the system (Phin, 1997:7). There is ample scope to spread this technique to all over Japan. But prior to make a mass campaign for this technique it would be necessary for the government for ensured selling of this chemical free rice at a relatively higher price so that its producers get incentives and encouragement to practise this method on a regular basis.

4. Organic farming has the potential to provide benefits in terms of environmental protection, conservation of no-renewable resources, improved food quality, reduction in output of surplus products and the reorientation of agriculture towards areas of market demand (Lampkin and Padel, 1994:3). The question may arise whether the organic farming is financially sound or not. Although it is difficult to get a suitable answer but it is at least possible that even, if it were true that organic farming is *"financially"* unsound, it might still be *"economically"* justified. Considering its importance and potentialities Germany, Denmark, Sweden, Finland, Norway, Switzerland, Austria and the Netherlands have now full-time state-funded advisers specializing in organic farming (*Ibid*). In Yamaguchi Prefecture, there are a number of integrated organic farms for the production of chemical free vegetables, fruits, milk, meat, eggs, butter, cheese, ice cream , chocolates and to some extent rice. At Hiroshima Prefecture 200 farm families have so far been identified who are practicing organic rice culture (Kashem and Mikuni, 1998). Although till date the organic farm producers have not faced severe problems in selling their produces since they have contact consumers. But during discussion on this aspect the owners / managers of those farms apprehended that it is not unlikely that in the near future there would be acute problems in marketing their organic food products profitably.

The foregoing discussion lead one to conclude that organic farming in Japan would not be able to sustain unless government considers it as national programme for sustainable agricultural development. Hence, considering the importance of organic farming towards healthy environment as well as sustainable agriculture, a massive motivational campaign from the government vehicle and missionaries are necessary to popularize organic food products and increase its use on a large scale. For creating mass awareness the information on the benefits and advantages of organic farming should be conveyed through popular mass media viz. radio, television and newspapers effectively in such a way that farmers become interested to learn this practice in their normal farming practice. The administrators, policy makers and concerned authorities should give due cognizance of these facts and take necessary steps to implement the idea.

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持続的農業発展と日本農民の農業技術

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この研究は持続的農業発展を達成するために稲作、野菜、果樹、花の栽培で、日本の農民が使用した農業技術に焦点を当てる。資料は1997年9月15日から11月10日の間に農協の営農指導員によって、ランダムに45戸の農家からの面接調査によって集められた。農民による農業技術を評価するために4ポイントリカートタイプの表が用いられた。農業技術の使用指標は使用された技術を順位づけるために計算された。分析結果は持続的農業技術の使用では、稲作が最も高く、ついで野菜、花、果樹の順であった。また農民の農業技術の使用は彼らの農家規模と情報源への接触ときわめて積極的な相関関係を有していた。

キーワード：持続的農業、農業技術、農業情報