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Validation of Participatory Farming Situation Identification: Case of Rainfed Rice Cultivation in Selected Area of West Bengal, India

Rupak Goswami
Integrated Rural Development and Management Faculty Centre, Ramakrishna Mission Vivekananda University, Ramakrishna Mission Ashrama, Narendrapur, Kolkata-700103, West Bengal, India
Phone: 91-033-24772020; 9433246593
Fax-033-24772020;
E mail: goswamirupak@rediffmail.com

Malay Sankar Biswas
Integrated Rural Development and Management Faculty Centre, Ramakrishna Mission Vivekananda University, Ramakrishna Mission Ashrama, Narendrapur, Kolkata-700103, West Bengal, India

Debabrata Basu
Department of Agricultural Extension, Agricultural Economics & Agricultural Statistics (EES), Institute of Agriculture, Visva-Bharati, Sriniketan-731236, West Bengal, INDIA
Phone: 91-033-25824590; 9830031075
E mail: drdbasu@gmail.com

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Abstract

It is important to develop valid field tools that can identify homogeneous farming situations that facilitates offering of appropriate agricultural technology to farmers. The present study was conducted to test the validity of such a novel participatory field tool that can identify micro farming situation with special reference to rainfed rice cultivation in selected village of North 24 Parganas District of West Bengal, India. A Micro farming situation was conceptualised as a sub-system of a relatively large farming situation, which is relatively homogeneous in nature. Farmers of the village themselves classified their agricultural fields into distinct micro-farming situations through participatory mapping exercise. All the 70 farmers growing rainfed rice in that uninterrupted field were then interviewed for recording their rainfed rice cultivation practices. Most of the rainfed rice cultivation practices like variety selection, time of sowing, transplanting and harvesting, seed rate, seedling age, spacing, plant protection practices, fertilizer management and yield differed significantly among these identified micro-farming situations. This indicated the effectiveness of farmers' classification. However, more empirical evidence is needed – especially for different field crops – to establish the validity of this tool. The tool can help to offer appropriate technologies to the farmers for a technically precise and environmentally sound agriculture.

Keywords: micro-farming situation, farmers' classification, validation of indigenous classification, rainfed rice, appropriate technology

"Microenvironment unobserved"

Both in agricultural and social sciences, complexity and diversity has been under perceived and undervalued which resulted in its neglect, under estimation and exclusion from government statistics and policy framework[1]. The archetypal Green Revolution technologies and 'transfer-of-technology' paradigm has also historically failed to cater to the needs of resource-poor agro-ecosystem in the third world[2]. Extension offered blanket recommendation for wide geographical area and was used as a deterministic 'dart gun'[3] i.e., 'take the technology and transfer to the farmers'. The heterogeneity of the farming systems for which different technologies were needed, has been ruefully ignored. As a result, the adoption of agricultural technologies has remained astonishingly low in comparison to commercial innovations.

The Farming System Approach and Recommendation Domain

Fortunately, farmers' reality and farm reality has, of late, been considered duly by the researchers, policy makers and extension personnel, although mainstreaming has remained underachieved. This era may be marked as the Farming System Research (FSR) paradigm of research and development. Examples received from different parts of the globe reemphasise the need to examine 'recommendation domains (RD)' – an archetypal concept associated with FSR – carefully and in detail, even in cases in which technologies are developed and already in use by farmers operating under what appear to be circumstances quite similar to possible 'recipients' of such technologies[4]. A RD is a group of farmers whose circumstances are similar enough that they will be eligible for the same recommendation[5]. This basic idea of targeting can be found in the context of social marketing[6] and this is also advocated by extensionists[3].

The classification of the farming situations of developing regions has been based on criteria like – available natural resource base, including water, land, grazing areas and forest; climate, of which altitude is one important determinant; landscape, including slope; farm size, tenure and organization; dominant pattern of farm activities and household livelihoods, including field crops, livestock, trees, aquaculture, hunting and gathering, processing and off-farm activities; and taking into account the main technologies used, which determine the intensity of production and integration of crops, livestock and other activities[7]. Generally, the researchers select some relevant variables related to the farming system in question (like land holding, other sources of income, investment in farming, education etc.) followed by the clustering of these selected variables resulting in some RDs. But, these variables are necessarily selected by the scientists or outsiders without any formal participation of farmers for whom the technology is offered. Although limited farmer participation in RD identification can be found in few cases[8].

Micro farming situation

At the centre of the concept of MFS is the idea of micro-environment. Chambers (1990) defined a micro-environment as a distinct small-scale environment which differs from its surroundings[1]. A micro farming situation may be thought as a sub-system of a relatively large farming situation, which is relatively homogeneous in nature and also possesses some distinguishable characteristics from the larger system or from another such sub-system. The criteria, on the basis of which a particular micro farming situation is constructed of, or distinguished from another micro farming situation, is strictly subjective and defined by the perception of the farmers. While making decisions regarding any farming activity, those micro farming situations are consulted upon by the farmers. This strict, subjective characterisation of farming situations may not be identified and appreciated by the scientists, researchers and extension workers. The criteria or attributes of discrimination may be as diverse as land use, soil type, irrigation facilities, water regime, cropping sequences, drainage facility, slope, biophysical problems, cost of land, fertility status, other facilities etc.

Understanding of micro farming situation is an inseparable issue of analysing farm heterogeneity and it provides a logical elaboration of the recommendation domain (RD) with an additional element of ensured farmer participation[9]. The advantages of such classification are – it understands the diversity of farming system and farming community, identifies the criteria of such differentiation, appreciates differential technological requirements for different RD, offers appropriate on-shelf technologies to different RD and develops appropriate technology through specific trials for particular RD.

Indigenous knowledge and classification system

The role of indigenous knowledge in agricultural development has received fresh enquiry and recognition in the 1980s especially during and after the IDS Workshop at Sussex in 1987. Indigenous classification has also been studied extensively during this time. Local people use many categories in different parts of the world to describe types of soil[10], lands[11], landscapes, crops, wild plant species [12] and other natural resources. The categories and names used by them usually differ from those used by scientists. These criteria of classification are often functional unlike the standard categorisation criteria derived from physical sciences[13].

The scientists' classification is based on a set of predetermined criteria which are validated in terms of scientific principles. But it requires lots of time and resources. Still, this may miss criteria which are experienced by the common people. On the other hand, farmers' classification is subjective, functional and never claims validity outside their own context. It is quick, resource saving and more empowering if targeting of technology is done on the basis of farmers' classification[14].

Validation of indigenous knowledge

Indigenous knowledge has got rid of its 'primitive' labels only recently. This development started in the 60's with anthropologists' ethnoscience research and continued in the 70's by the development of Farming Systems Research philosophy and increasing formal studies on indigenous knowledge[15, 16].

Quite some of the cited reports have tested the 'validity' and 'objectivity' of indigenous classifications, using technical analysis methods[17] and clustering programs and other statistical procedures[18,19,11]. They concluded that distinctions made by indigenous people were all scientifically valid and statistically testable. Although, some scholar argue that in order to legitimize indigenous knowledge, it should not be necessary to measure and 'scientize' it in terms of formal Western methods and scientific principles, since the value of such knowledge has been proved over centuries and scientific systematization may misinterpret the cultural value and 'subtle complex nuances' of these knowledge systems[15]. Although this point is of true merit, analyzing indigenous knowledge using scientific methods could still yield many valuable lessons for scientists and extensionists and provide complementary information useful for both 'them' and 'us'.

Rice cultivation – especially, 'aman' (rainfed) cultivation – has been taken for the present study on the ground that it is practiced by almost all the farmers everywhere in the eastern India. Rainfed rice has been cultivated for generations and its cultivation practice, associated knowledge and skill are more or less standardized within a family/community. Moreover, as it is cultivated across the state and country, the replication of the study will become more relevant.

The present study was undertaken to classify the micro-farming situations of the study area according to farmers' perception and to compare the rice cultivation practices of farmers across these identified micro-farming situations. The significant difference of rainfed rice growing practices among the identified MFSs will validate the farmers' classification of rainfed rice farming situation.

Methodology

The study was conducted at village Tangra Colony of Tangra Colony Gram Panchayat (democratically elected local self-governing body) of North 24 Parganas District, West Bengal. Multistage random sampling was followed for the selection of the administrative Block and Gram Panchayat (GP). The study village was selected randomly from the major rice growing villages of the GP having rice fields at one stretch and a manageable population that may be covered in the study. Total enumeration technique was followed for the selection of rice growers, the sample size being 70. Classification of the rice growing situation was done through participatory MFS analysis through manual discrimination[20]. This involved elements of participatory mapping[21] where farmers drew different distinct MFS of the rice field and listed down the criteria on the basis of which the classification was done. In-depth interview was done with the farmers for the collection of information on rainfed rice cultivation practices of the farmers. The items of the data collection instruments were finalized in consultation with the farming community[22]. Farming practices of farmers in different MFS was then compared by Chi-square test and one-way ANOVA for examining the validity of farmers' manual discrimination in identifying MFS. SPSS for Windows was used for the analysis of data.

Results and discussion

The analysis of collected data through personal interview and participatory mapping has been presented as (i) description of respondents' background situation, (ii) description of respondents' rainfed rice growing practices, (iii) description of different micro-farming situations and their characteristics, and (iv) comparison of farmers' rainfed rice cultivation practices across micro-farming situations.

Table 1 Distribution of respondents by selected background variables (N=70)

Variables with category	Frequency (%)	Variables with category	Frequency (%)
Age		Homestead area	
<30	04 (05.71)	<1 bigha	57 (81.43)
31-45	20 (28.57)	1-2 bigha	08 (11.43)
>45	46 (65.71)	>2 bigha	07 (10.00)
Family Size		Ownership status of land	
Small (<3)	07 (10.00)	Own	46 (65.71)
Medium (3-5)	35 (50.00)	Share cropping	03 (04.29)
Large (>5)	28 (40.00)	Leased in	21 (30.00)
Education		Area under rice cultivation	
Illiterate	10 (14.29)	0-7.5 bigha	38 (54.29)
Primary	17 (24.29)	7.6-15 bigha	25 (35.71)
Secondary	26 (37.14)	>15 bigha	07 (10.00)
Above secondary	17 (24.29)		
Occupation		Area of pond	
Agriculture	36 (51.43)	No pond	31 (44.29)
Mixed	16 (22.86)	<1 bigha	32 (45.71)
Non agriculture	18 (25.71)	>1 bigha	07 (10.00)
Income from agriculture (%)		Material possession	
High	37 (52.86)	High	15 (21.43)
Medium	19 (27.14)	Medium	27 (38.57)
Low	14 (20.00)	Low	28 (40.00)

Experience in rainfed rice cultivation		Farm implement ownership	
<10 years	11 (15.71)	High	18 (25.71)
11-20 years	21 (30.00)	Medium	33 (47.14)
21-30 years	22 (31.43)	Low	19 (27.14)
> 30 years	16 (22.86)		
Upland		Cattle ownership	
No land	18 (25.71)	High	09 (12.86)
0-4 bigha*	39 (54.93)	Medium	20 (28.57)
> 4 bigha	13 (18.57)	Low	17 (24.29)
		No	24 (34.29)
Medium Land		Goat ownership	
No land	12 (17.14)	High	06 (08.57)
0-4 bigha	31 (44.29)	Medium	08 (11.43)
> 4 bigha	27 (38.57)	Low	10 (14.29)
		No	46 (65.71)
Low land		Poultry ownership	
No land	15 (21.43)	High	04 (05.71)
0-4 bigha	31 (44.29)	Medium	12 (17.14)
> 4 bigha	24 (34.29)	Low	10 (14.29)
		No	44 (62.86)
Total land holding		Received training on farming	
0-7.5 bigha	25 (35.71)	Yes	13 (18.57)
7.6-15 bigha	36 (51.43)	No	57 (81.43)
>15 bigha	09 (12.86)		

* 1 bigha=0.133 ha

The distribution of rice growers according to different background variables is given in Table 1. The categories of farmers' background variable were finalized in consultation with the farmers whenever statistical categorization was not found suitable. That means, for such cases, data have been presented in a way to make sense to the farmers first, rather than the commonly used statistical classifications.

Most of the farmers in the study area were aged (65.71% above 45 years of age) and they were experienced cultivators (31.43% having 21-30 years and 22.86% having more that 30 years of experience in rainfed rice cultivation). That means the rainfed rice cultivation practice was standardized over a considerable period of time within the community. The farming households were predominantly medium (3-5 members) to large (more than 5 members) in size (50% medium and 40% large), which could act as a source of family labour, especially during the intercultural operations. Farmers were found to be well educated (37.14% secondary and 24.29% higher secondary and above). Although a significant section of the community (25.71%) depended on non-agricultural occupation for sustaining livelihoods, the highest source of income was coming from agriculture alone (51.43%). Size of cultivable land was mostly medium (51.43%) to low (35.71%). Although most of the farmers cultivated in own lands (65.71%), a significant number of farmers leased in land for cultivation (30%). This influenced their management practices. Management practices in leased in lands were more intensive than the owned lands as the cultivators tried to exploit leased in lands more than their own land. Almost all the cultivable lands were found to be under rice cultivation as this was the staple food of the farm families. The farm families owned small homestead areas (81.43% being less than 1 bigha) and maintained the same for non-agricultural purposes. Some of the farmers (55.71%) had small water bodies (45.71% being less than 1 bigha and only 10% more than 1 bigha) which were used for non-commercial fishery and small scale irrigation of winter crops. Farmers had moderate material possession (21.43% high, 38.57% medium, 40% low) and agricultural implement possession (25.71% high, 47.14% medium, 27.14% low). Most of the farmers kept cattle (65.71%) but little small livestock (34.29%) or poultry birds (37.14%). Cattle were used mostly for producing milk, which was consumed domestically. Farmers had little or no extension training in agriculture (18.57%), indicating little extension support in scientific rice farming.

Table 2 Distribution of respondents by different rainfed rice cultivation practices (N=70)

Rice cultivation Practices	Frequency (%)	Rice cultivation Practices	Frequency (%)
Variety		Seedling Treatment	
Birpala	04 (05.71)	Yes	21 (30.00)
IET 5656	13 (18.57)	No	49 (70.00)
Ranjit	16 (22.86)		
Sabita	03 (04.29)		
Sonamukhi	12 (17.14)		
Swarna Masuri	20 (28.57)		
Others	02 (02.86)		
Time of Sowing		Spacing	
4th week of May	41 (58.57)	Close (p-p - 6″)	10 (14.29)
1st week of June	25 (35.71)	Medium (p-p - 7″)	45 (64.29)
After 1st week of June	04 (05.71)	Wide (p-p - 8″)	15 (21.43)
Seed rate		Seedling age during	
Upto 8 kg/bigha*	10 (14.29)	transplanting	02 (02.86)
9-10 kg/bigha	20 (28.57)	Upto 4 weeks	28 (40.00)
11-12 kg/bigha	23 (32.86)	4-5 weeks	40 (57.14)
More than 12 kg/bigha	17 (24.29)	5-6 weeks	
Seed Treatment		Plant Protection	
Yes	59 (84.29)	No pesticide	05 (07.14)
No	11 (15.71)	Single pesticide	35 (50.00)
		More than one pesticide	30 (42.86)
Fertilizer in seed bed		Harvesting	
Upto 4 kg/katha**	05 (07.14)	4th week of November	21 (30.00)
5-6 kg/katha	24 (34.29)	1st week of December	20 (28.57)
7-8 kg/katha	24 (34.29)	2nd week of December	20 (28.57)
More than 8 kg/katha	17 (24.29)	3rd week of December	09 (12.86)
Land Preparation		Weeding	
Plough	31 (44.29)	Two	10 (14.29)
Power tiller	39 (55.71)	Three	44 (62.86)
		Four	16 (22.86)
Date of Transplanting		Top dressing Nitrogen	
4th week of June	08 (11.43)	Upto 10 kg/bigha	19 (27.14)
1st week of July	40 (57.14)	11-13 kg/bigha	25 (35.71)
2nd week of July	19 (27.14)	14-16 kg/bigha	18 (25.71)
3rd week of July	03 (04.29)	Above 16 kg/bigha	08 (11.43)
Basal Nitrogen		Top dressing Phosphorus	
Upto 10 kg/bigha	10 (14.29)	Upto 8 kg/bigha	37 (52.86)
11-15 kg/bigha	46 (65.71)	9-10 kg/bigha	18 (25.71)
More than 15 kg/bigha	14 (20.00)	11-12 kg/bigha	11 (15.71)
		Above 12 kg/bigha	04 (05.71)

Basal Phosphorus		Top dressing Potash	
Upto 10 kg/bigha	51 (72.86)	Upto 8 kg/bigha	38 (54.29)
11-15 kg/bigha	16 (22.86)	9-12 kg/bigha	22 (31.43)
More than 15 kg/bigha	03 (04.29)	13-16 kg/bigha	08 (11.43)
		Above 16 kg/bigha	02 (02.86)
Basal Potash		Yield (quintal***/bigha)	
Upto 7 kg/bigha	19 (27.14)	<9	16 (22.86)
8-10 kg/bigha	29 (41.43)	9-10	22 (31.43)
More than 10 kg/bigha	22 (31.43)	11-12	21 (30.00)
		>12	11 (15.71)

* 1 bigha=0.133 ha; ** 1 katha=.007 ha; *** I quintal = 0.1 ton

The distribution of rice growers according to their rice cultivation practices is shown in Table 2. Swarna masuri was found to be the most popular variety (28.57%) among the farmers followed by Ranjit (22.86%), IET 5656 (18.57) and Sonamukhi (17.14%). Almost all the farmers used to sow rice either during the 4th week of May (58.57%) or 1st week of June (35.71%). However, most of the farmers transplanted rice during the first (57.14%) and second week (27.14%) of July. This delay was due to irregularity of rainfall and availability of labour for transplantation. Amount of seed sown in seed bed varied widely among the farmers. Most of the farmers used to sow 11-12 kg seed per bigha (32.86%) followed by 9-10 kg per bigha (28.57%) followed by 'more than 12 kg per bigha' (24.29%) and 'less than 8 bigha' (14.29%). Majority of the farmers (84.29%) treated seed before sowing. However, most of the farmers (70%) did not treated seedlings before transplanting. Seedlings were mostly 5-6 weeks (57.145) or 4-5 weeks (40.00%) old during transplanting. Spacing of seedlings were found to be mostly medium (64.29%) to wide (21.43%). Only 14.29% farmers adopted closer spacing for late transplanting. More than half of the farmers (55.71%) used power tiller for land preparation. Most of the farmers (62.86%) weeded their field for three times, while 22.86% and 14.29% farmers afforded four and two manual weeding. Nutrient management also widely varied among the rice growers. In seedbed, 34.29% farmers applied 5-6 kg per katha or 7-8 kg per katha fertilizer in seed bed, followed by 'more than 8 kg per katha' (24.29%) and 'less than 4 kg per katha' (11.43%). Majority of the farmers (65.71%) applied 11-15 kg Nitrogenous fertilizers per bigha as basal application followed by 'more than 15 kg/bigha' (20.00%) and 'upto 10 kg per bigha' (14.29%). Corresponding figures for Phosphatic fertilizers were recorded to be 72.86% (upto 10 kg per bigha), 22.86% (11-15 kg per bigha) and 4.29% (more than 15 kg per bigha) and for Potassic fertilizers these were 41.43% (8-10 kg per bigha), 31.43% (more than 10 kg per bigha) and 27.14% (upto 7 kg per bigha). For top dressing, 35.71% of the farmers applied 11-13 kg Nitrogenous fertilizer per bigha, followed by 'upto 10 kg per bigha' (27.14%), 14-16 kg per bigha (25.71%) and 'above 16 kg per bigha' (11.43%). These figures for Phosphatic fertilizers were 52.86% (upto 8 kg per bigha), 25.71% (9-10 kh per bigha), 15.71% (11-12 kg per bigha) and 5.71% (above 12 kg per bigha) and for Potassic fertilizers these were 54.29% (upto 8 kg per bigha), 31.43% (9-10 kh per bigha), 11.43% (11-12 kg per bigha) and 2.86% (above 12 kg per bigha). Most of the farmers used one (50.00%) or more (42.86%) pesticides for controlling pest of rainfed rice. Yield varied widely from less than 9 quintal per bigha (22.86%) to more than 12 quintal per bigha (15.71%). However, most of the farmers had a yield in between 9-12 quintal per bigha (61.43%).

The rice growers of the village identified five MFSs of distinct characteristics on the basis of their perception (Fig. 1). They also gave local name to those MFSs for easy communication within the community.

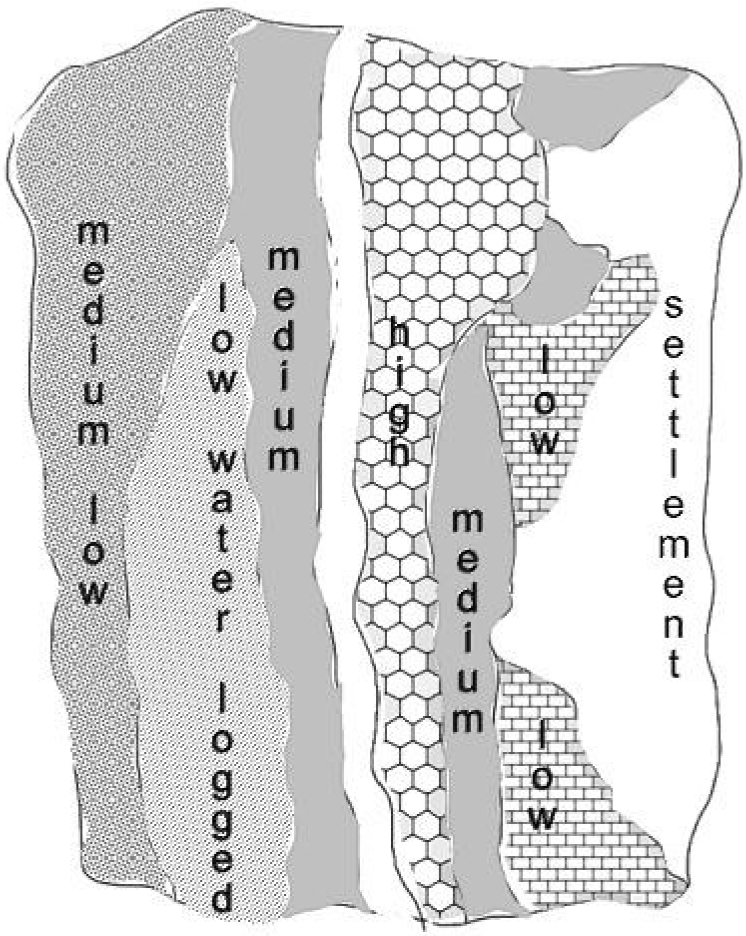

Figure 1. Micro-farming Situation Map of Tangra Colony village

Figure 1 shows different MFSs identified by the farming community of village Tangra Colony. The contiguous rice field was classified by the farmers into different MFS according to their perception. During the mapping exercise, these criteria were listed on paper. Both bio-physical and managerial attributes were consulted upon by the farmers during manual discrimination of the MFS (Table 3). It may be observed that farmers did not use only the criteria related to the properties of soil like soil structure, texture, soil reaction, salinity, water holding capacity, humus content; they also mentioned source of irrigation, manure and fertilizer application, varieties grown, harvesting time and productivity as important criteria for classification. This unique way of considering a whole gamut of classification made this classification important for managerial decisions of farmers regarding cultivation practices.

Table 3 Description of micro-farming situations in terms of farmers' perceived attributes (no. of farmers in parenthesis)

High land (13)	Medium land (23)	Medium-low land (15)	Low water logged land (07)	Low land – Highly Fertile (12)
✓Soil slightly saline ✓Soil fragile in nature ✓Irrigation source – rainwater & water drawn by deep tube well ✓Productivity of rice- medium	✓ Water holding capacity - high ✓ Humus content- high ✓ Irrigation source- rain water ✓ Fertilizer application - medium ✓ Potash content - high ✓ Productivity of rice- Medium	✓ Soil slightly acidic ✓ Sandy soil ✓ Water retention- moderate ✓ Irrigation source- Rain water ✓ FYM- frequently applied Application of fertilizers- moderate	✓ High clay content ✓ Mostly local varieties grown ✓ Fertilizers application- low ✓ Late harvesting	✓Alluvial, high silt deposition ✓High water retention capacity ✓Irrigation source – rain water ✓Fertile ✓Fertilizer application is very low ✓Harvesting - early

Now the concern was to examine how the rice growing practices differed in these identified micro-farming situations (Table 4).

Table 4 Distribution of respondents by rainfed rice cultivation practices in different micro-farming situations (N=70)

Rice cultivation Practices	Frequency (%)				
	High	Medium	Low medium	Water logging	Low fertile
Variety					
Birpala	2 (2.9)	0 (0.0)	1 (1.4)	0 (0.0)	1 (1.4)
IET 5656	2 (2.9)	4 (5.7)	2 (2.9)	2 (2.9)	3 (4.3)
Ranjit	2 (2.9)	5 (5.7)	4 (5.7)	1 (1.4)	4 (5.7)
Sabita	1 (1.4)	0 (0.0)	1 (1.4)	1 (1.4)	0 (0.0)
Sonamukhi	3 (4.3)	5 (5.7)	1 (1.4)	1 (1.4)	2 (2.9)
Swarna Masuri	3 (4.3)	9 (12.9)	4 (5.7)	2 (2.9)	2 (2.9)
Others	0 (0.0)	0 (0.0)	2 (2.9)	0 (0.0)	0 (0.0)
Time of Sowing					
4th week of May	6 (8.6)	11 (15.7)	11 (15.7)	6 (8.6)	7 (10.0)
1st week of June	7 (10.0)	9 (12.9)	3 (4.3)	1 (1.4)	5 (5.7)
After 1st week of June	0 (0.0)	3 (4.3)	1 (1.4)	0 (0.0)	0 (0.0)
Seed rate					
Upto 8 kg/bigha*	2 (2.9)	6 (8.6)	0 (0.0)	0 (0.0)	2 (2.9)
9-10 kg/bigha	2 (2.9)	8 (11.6)	7 (10.0)	2 (2.9)	1 (1.4)
11-12 kg/bigha	4 (5.7)	5 (5.7)	6 (8.6)	2 (2.9)	6 (8.6)
More than 12 kg/bigha	5 (5.7)	4 (5.7)	2 (2.9)	3 (4.3)	3 (4.3)
Seed Treatment					
Yes	1 (1.4)	3 (4.3)	3 (4.3)	2 (2.9)	2 (2.9)
No	12 (17.1%)	20 (28.6)	12 (17.1%)	5 (5.7)	10 (14.3)

Fertilizer in seed bed					
Upto 4 kg/katha**	0 (0.0)	2 (2.9)	3 (4.3)	0 (0.0)	0 (0.0)
5-6 kg/katha	3 (4.3)	8 (11.6)	8 (11.6)	2 (2.9)	3 (4.3)
7-8 kg/katha	6 (8.6)	9 (12.9)	3 (4.3)	0 (0.0)	6 (8.6)
More than 8 kg/katha	3 (4.3)	4 (5.7)	1 (1.4)	5 (5.7)	3 (4.3)
Land Preparation					
Plough	5 (5.7)	10 (14.3)	8 (11.6)	3 (4.3)	5 (5.7)
Power tiller	8 (11.6)	13 (18.6)	7 (10.0)	4 (5.7)	7 (10.0)
Date of Transplanting					
4th week of June	1 (1.4)	3 (4.3)	2 (2.9)	1 (1.4)	1 (1.4)
1st week of July	8 (11.6)	11 (15.7)	10 (14.3)	4 (5.7)	7 (10.0)
2nd week of July	4 (5.7)	7 (10.0)	2 (2.9)	2 (2.9)	4 (5.7)
3rd week of July	0 (0.0)	2 (2.9)	1 (1.4)	0 (0.0)	0 (0.0)
Basal Nitrogen					
Upto 10 kg/bigha	2 (2.9)	2 (2.9)	2 (2.9)	1 (1.4)	3 (4.3)
11-15 kg/bigha	10 (14.3)	14 (20.0)	10 (14.3)	5 (5.7)	7 (10.0)
More than 15 kg/bigha	1 (1.4)	7 (10.0)	3 (4.3)	1 (1.4)	2 (2.9)
Basal Phosphorus					
Upto 10 kg/bigha	10 (14.3)	16 (22.9)	11 (15.7)	4 (5.7)	10 (14.3)
11-15 kg/bigha	3 (4.3)	6 (8.6)	2 (2.9)	3 (4.3)	2 (2.9)
More than 15 kg/bigha	0 (0.0)	1 (1.4)	2 (2.9)	0 (0.0)	0 (0.0)
Basal Potash					
Upto 7 kg/bigha	3 (4.3)	9 (12.9)	5 (5.7)	0 (0.0)	2 (2.9)
8-10 kg/bigha	6 (8.6)	7 (10.0)	5 (5.7)	5 (5.7)	6 (8.6)
More than 10 kg/bigha	4 (5.7)	7 (10.0)	5 (5.7)	2 (2.9)	4 (5.7)
Seedling Treatment					
Yes	2 (2.9)	8 (11.6)	6 (8.6)	2 (2.9)	3 (4.3)
No	11 (15.7)	15 (21.4)	9 (12.9)	5 (5.7)	9 (12.9)
Spacing					
Close	2 (2.9)	4 (5.7)	2 (2.9)	2 (2.9)	0 (0.0)
Medium	9 (12.9)	15 (21.4)	11 (15.7)	4 (5.7)	6 (8.6)
Wide	2 (2.9)	4 (5.7)	2 (2.9)	1 (1.4)	6 (8.6)
Seedling age during transplanting					
Upto 4 weeks	1 (1.4)	0 (0.0)	1 (1.4)	0 (0.0)	0 (0.0)
4-5 weeks	3 (4.3)	10 (14.3)	7 (10.0)	5 (5.7)	3 (4.3)
5-6 weeks	9 (12.9)	13 (18.6)	7 (10.0)	2 (2.9)	9 (12.9)
Plant Protection					
No pesticide	2 (2.9)	2 (2.9)	0 (0.0)	0 (0.0)	1 (1.4)
Single pesticide	7 (10.0)	12 (17.1)	6 (8.6)	4 (5.7)	6 (8.6)
More than one pesticide	4 (5.7)	9 (12.9)	9 (12.9)	3 (4.3)	5 (5.7)
Harvesting					
4th week of November	2 (2.9)	8 (11.6)	8 (11.6)	1 (1.4)	0 (0.0)
1st week of December	2 (2.9)	8 (11.6)	6 (8.6)	2 (2.9)	7 (15.7)
2nd week of December	7 (15.7)	3 (4.3)	1 (1.4)	2 (2.9)	5 (5.7)
3rd week of December	2 (2.9)	4 (5.7)	0 (0.0)	2 (2.9)	0 (0.0)
Weeding					
Two	2 (2.9)	3 (4.3)	1 (1.4)	3 (4.3)	1 (1.4)
Three	7 (10.0)	14 (20.0)	11 (15.7)	4 (5.7)	8 (11.6)
Four	4 (5.7)	6 (8.6)	3 (4.3)	0 (0.0)	3 (4.3)

Top dressing Nitrogen					
Upto 10 kg/bigha	9 (12.9)	3 (4.3)	1 (1.4)	3 (4.3)	5 (5.7)
11-13 kg/bigha	3 (4.3)	11 (15.7)	0 (0.0)	4 (5.7)	2 (2.9)
14-16 kg/bigha	1 (1.4)	8 (11.6)	8 (11.6)	0 (0.0)	3 (4.3)
Above 16 kg/bigha	0 (0.0)	1 (1.4)	6 (8.6)	0 (0.0)	2 (2.9)
Top dressing Phosphorus					
Upto 8 kg/bigha	12	9 (12.9)	6 (8.6)	3 (4.3)	7 (10.0)
9-10 kg/bigha	1 (1.4)	7 (15.7)	6 (8.6)	2 (2.9)	2 (2.9)
11-12 kg/bigha	0 (0.0)	4 (5.7)	2 (2.9)	2 (2.9)	3 (4.3)
Above 12 kg/bigha	0 (0.0)	3 (4.3)	1 (1.4)	0 (0.0)	0 (0.0)
Top dressing Potash					
Upto 8 kg/bigha	9 (12.9)	12 (17.1%)	7 (10.0)	5 (5.7)	5 (5.7)
9-12 kg/bigha	3 (4.3)	8 (11.6)	5 (5.7)	1 (1.4)	5 (5.7)
13-16 kg/bigha	1 (1.4)	2 (2.9)	2 (2.9)	1 (1.4)	2 (2.9)
Above 16 kg/bigha	0 (0.0)	1 (1.4)	1 (1.4)	0 (0.0)	0 (0.0)
Yield (quintal/bigha***)					
<9	2 (2.9)	7 (10.0)	2 (2.9)	1 (1.4)	4 (5.7)
9-10	4 (5.7)	5 (5.7)	7 (10.0)	2 (2.9)	4 (5.7)
11-12	5 (5.7)	6 (8.6)	5 (5.7)	3 (4.3)	2 (2.9)
>12	2 (2.9)	5 (5.7)	1 (1.4)	1 (1.4)	2 (2.9)

* 1 bigha=0.133 ha; ** 1 katha=.007 ha; *** I quintal = 0.1 ton

It may be observed from Table 4 that IET 5656, Sonamukhi, Ranjit and Swarna masuri were grown in all MFSs. The reasons behind the preference of Sonamukhi variety were - high productivity, short harvesting time, high demand in the rice market, good taste and availability of certified seeds in the local market. Ranjit was preferred because of its suitability to withstand prolonged water logging condition. The reasons behind selection of IET 5656 and Swarnamasuri were - high productivity, thin grain of parboiled rice, less glutinous grain after boiling etc. Besides, these varieties could be cultivated in uplands under assured irrigation and sufficient fertilizers. Other high yielding varieties like Sabita, Birpala, Lal Swarna, Nayan Mani were also grown as substitutes of above mentioned varieties when seeds of those varieties were not available in the local market. Both sowing and transplantation were relatively earlier for the low waterlogged and low fertile fields because of their higher moisture in soil after the first monsoon rain. However, late sowing and transplantation were not observed in uplands and medium lands as assured irrigation was there in those fields. Seed treatment was common among the farmers and did not vary much among the farmers cultivating in different MFSs. On the contrary, seedling treatment was not common among the farmers. But, like seed treatment, seedling treatment, too, did not differ among MFSs. Seed rate was low for the waterlogged and low fertile lands as little fertilizer would be used for these MFSs and productivity was not a concern for the farmers. Fertilizer application in seedbed did not vary much with MFS as little fertilizer was needed in seedbed and all farmers could afford this cost. Land preparation did not also differ with MFS because using plough or power tiller was a matter of access and financial capacity. It did not depend on biophysical conditions of the MFSs. Basal N and P applied in the field were higher in upland and medium land situation than the waterlogged and low fertile lands as little or no fertilizer could be applied in waterlogged situation. Moreover, indigenous varieties were mostly grown in those land situations which were less fertilizer responsive. The same logic applied for top dressing. However, unlike basal dose, N and K, instead of N and P, differed among MFSs. Spacing of plant was wider for upland and low fertile MFS where tillering of the plants would be more than that of other MFSs. Seedling age was observed to be more for highland and medium land situations. This was due to relatively less moisture content of the lands and even though farmers had access to irrigation water they would wait for rainfall to minimize irrigation cost. Plant protection measures were used more in upland and medium land situation as there were more HYV, more fertilizer application and more weed infestation. The same reason resulted in more number of weeding in those MFSs in comparison to waterlogged and low fertile MFS. Moreover, wider spacing of upland spacing encouraged weed growth. Harvesting time differed significantly among the MFSs. In upland and medium land situation, harvesting was earlier than the waterlogged and low fertile MFS as many of the upland varieties were of smaller duration and paddy could not be harvested from the low lands until water was removed from the field. Yield of high and medium land situation was found to be higher than that of other MFSs.

The last task was to examine statistically if the rice cultivation practices of farmers differed significantly among the identified MFSs of the study area. From Table 5 it is observed that most of the rainfed rice cultivation practices differed among the MFSs. These include variety selection, time of sowing, transplanting and harvesting, seed rate, seedling age at transplanting, spacing, plant protection practices, fertilizer in seed bed, basal dose of Nitrogenous and Phosphatic fertilizers, top dressing dose of Nitrogenous & Potashic fertilizers, weeding and yield.

Table 5 Difference in rainfed rice cultivation practices among the five micro-farming situations

Rice cultivation practices	Chi-square/ F value	df	Chi-square/ F significance (P value)
Variety	60.75	24	0.006**
Tillage	06.52	4	NS
Time of Sowing	22.57	8	0.004**
Seed rate	02.76	4, 65	0.034*
Seed treatment	07.01	4	NS
Fertilizer application in seed bed	05.25	4, 65	0.001**
Seedling age	02.96	4, 65	0.026*
Basal N	03.95	4, 65	0.006**
Basal Phosphate	03.12	4, 65	0.021*
Basal Potash	01.72	4, 65	NS
Date of Transplanting	23.21	12	0.026*
Seedling treatment	02.44	4	NS
Spacing	23.12	8	0.003**
Plant protection chemicals used	18.23	4, 65	0.019*
Weeding by hired labour	48.41	8	0.000**
Top dressing N	12.51	4, 65	0.000**
Top dressing P	00.72	4, 65	NS
Top dressing K	06.12	4, 65	0.000**
Date of Harvesting	38.98	12	0.000**
Yield	03.13	4, 65	0.020*

* Significant at 1% level of significance; ** Significant at 5% level of significance

Conclusion

From the study it was clear that participatory analysis of MFS by farmers is highly efficient in differentiating rice growing situation in terms of their cultivation practices. Hence, this may be used as effective tool for classification of farming system and targeting appropriate technology by the extension agents. For example, the classification that differentiates rice cultivation practices efficiently may be considered as an effective tool for delineating appropriate recommendations for rainfed rice cultivation. This may also be used for recommendation domain identification for other crops. Another way of 'targeting' specific technologies (like agri-inputs, agri-implements, new variety etc.) for specific crop may be through the use of specific cultivation practice(s) for clustering farmers. For example, use of organic/inorganic fertilizer may be used to cluster farmers before the introduction of organic manure. The tool may also prove to be effective in micro-level agricultural planning by decentralised self-governing bodies like Gram Sansad.

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