

Original Research Article

**Farmer Participatory Research for Development of
Crop-specific Nutrient Management Practice under
Organic Farming System**

ABSTRACT

Aims: Low adoption of organic agriculture is one of the major challenges ~~to-of~~ agricultural extension ~~agents~~ working towards sustainable agriculture. The present ~~article-aims~~ article aims to develop ~~farming-system-based~~ nutrient management for five crops [Paddy (*Oryza sativa*), Chilli (*Capsicum annuum*), Bitter gourd (*Momordica charantia*), French bean (*Phaseolus vulgaris*) and Greengram (*Vigna radiata*)] under organic farming in two agro-climatic zones of the West Bengal State, India.

Study Design: The study ~~follows-followed~~ a systematic farmer-participatory research (FPR) approach for development of crop specific nutrient management practices. Based on the soil fertility and nutrient recommendation of the State Department of Agriculture for a crop, the nutrient was sourced from available natural resources of the farm families.

Results: The required nutrients were sourced from the available farm resources, mainly agricultural waste, animal excreta and urine etc., in consultation with the farmers. The exercise resulted in three nutrient packages each under each of the three farming systems of an agro-climatic zone. The packages were combinations of different ratios of bulky manure (FYM, poultry manure, goat manure, duck manure) and liquid manure (Sasyagavya) commensurate to their availability in a farm.

Conclusion: The principles of FPR may be used to develop farm-specific organic farming based nutrient packages. The packages may be used in the farmers' field for on-farm trials.

Comment [G. O.1]: This design is not self explanatory. The reader may not really understand what you did

Comment [G. O.2]: This should not be part of the result but methodology

Comment [G. O.3]: The conclusion should be deduced from the results of the experiment

UNDER PEER REVIEW

23 *Key Words: Farmer Participatory Research, Organic Farming, Farming System, Nutrient Management*

UNDER PEER REVIEW

24 1. INTRODUCTION

25 The ~~secret~~success of good organic farming lies in the better understanding of local agro-ecosystem. Unlike

26 ~~chemical-conventional~~ farming, little or no generic and readymade prescription is available for crop-specific organic

27 farming practices. The practices are so location/farm reliant that recommendation for a particular farming

28 system/agro-ecosystem may not be replicated elsewhere. Components in a farm are interrelated and one

29 must understand this complex inter-relationship before undertaking meaningful recommendations [1].

30 Hence, there is a need to understand the whole farming system instead of confining interventions within

31 the crop field. Therefore, 'System thinking' [2], i.e. a holistic understanding of the context of farming and

32 livelihoods of a farmer, will be needed to popularize organic farming, along with an explicit undertaking of

33 'Interdisciplinarity' in the practice of research and extension [3]. And perhaps the crux of the challenge lies

34 in the management of plant nutrients, which needs to be addressed in a holistic manner for sustaining

35 organic farming systems.

36 Farmers across the globe have cultivated crops since pre-historical period and their farming experience

37 and repertoire of knowledge have come down through ancestry. Farmers often understand better the

38 complexities and interdependencies prevailing within their own systems and also understand the local

39 environment, problems and their solution [4, 5, 6]. They act as natural experimenters, engaging

40 themselves in a number of experiments as part of their farming routine within the context of agro-

41 ecological and socio-economic circumstances. Thus, the farmers may be considered as potential

42 experimenters and experts in developing appropriate agro-technology or farming practices. Organic

43 farming might be an excellent scope of engaging farmers in formal research and extension [7, 8].

44 In spite of having a string of benefits [9], the adoption of organic farming has remained a huge challenge

45 for the extension systems. There is a well established mechanism to transfer green revolution

46 technologies in the developing countries, where the technologies are developed in research stations and

47 send to the farmers' field using persuasive means without considering the farmers' view point. The

48 followings are some of the issues that must be considered while developing and transferring for any

49 technology including location-specific organic farming practices. Are the farmers capable of affording the

50 technology? Are they technically comfortable with it? Is the technology suitable for their farming system?

Comment [G. O.4]: This is also true for conventional farming

51 Are the farmers in a position to access and modify technologies to suit their purpose? These are some of
52 the issues that must be considered while developing and transferring location-specific organic farming
53 practices, but the existing theory on adoption and diffusion of innovations does not explain many of these
54 issues related to organic farming. The interventions have to follow a different line of thinking for its
55 promotion [10] as well as it must work out the modalities of developing appropriate technologies.

56 Now it is clear that any research in the field of organic farming without considering the farmers' view point
57 is bound to yield limited success and hence, conventional extension system fails to bring organic farming
58 in the farmers' field. There is a clear need of farmer participatory research (FPR) while conducting any
59 research work on organic farming. FPR is a process where farmers, researchers and other stakeholders

60 are actively involved in designing, planning, implementing, monitoring and evaluation of a research work
61 [1]; farmers are considered as the leader and experts in this research process [7, 8]. Further, since
62 nutrient management is the key to successful organic farming, sourcing nutrient from within the farming
63 system itself tend to enhance the sustainability of organic farming system. The FPR must concentrate on
64 appropriate ways of nutrient sourcing that incorporates farmers' participation and matches farm
65 resources.

66 In the present article we ~~try to outline~~ the methodology of location and farming system specific
organic
67 packages for different crops under two agro-climatic zones of West Bengal. For that, we have identified
68 the three major farming systems under each agro-climatic zone, analyzed the nutrient of soils to
69 determine the requisite nutrients for individual crop by using available resources in a farming system and
70 develop crop specific organic packages recommendable for a farming system.

71

72 2. MATERIALS AND METHODS

73 2.1 Site Selection

74 Organic farming performs better in extreme climatic condition [11, 12, 13]. About 30% of the rainfed
75 farmers, predominantly resource poor, in remote areas of India are by default organic [14]. The rainfed
76 areas are more suitable for organic farming because of its low input use [15, 16]. So, out of six agro-
77 climatic zones of West Bengal, two extreme zones viz. red lateritic zone (RLZ) and coastal saline zone

Comment [G. O.5]: This is not peculiar to organic farming only

78 (CSZ) ~~have been~~were chosen for the present study (Table 1). For RLZ, scarcity of water is a
challenge in

79 agriculture while for CSZ excessive water and soil salinity pose a great problem. Purulia and South 24
80 Parganas districts, representatives of these two agro-climatic zones respectively, were chosen for
81 conducting the study.

82

83 **Table 1: Two selected agro-climatic zones and their characteristics**

Agro-climatic zones	District studied	Salient features
Coastal saline	South 24Parganas	Soils are mostly heavy clay containing higher salts of sodium, magnesium, potassium with organic matter at different stages of decomposition. Mostly neutral soils (pH 6.5 to 7.5). Electrical conductivity varies from 3.0 to 18.0 mm, rainfall 1600-1800 mm; salinity and water congestion limit good crop productivity.
Red lateritic	Purulia	Soils are coarse in texture, highly drained with honeycomb type of ferruginous concentration at a depth of 15 to 30cm; erosion prone; acidic in nature (pH 5.5 to 6.2); poor available nutrients; average rainfall 1100-1400 mm. which is spread over only three months, mid June to mid September., low moisture holding capacity and poor nutrient status limit crop productivity.

84

85 One village each under the selected blocks namely 'Kalla' of Udaypur Joynagar panchayat (rural self
86 governing body in India) and 'Paruldaha' of Brindakhali panchayat was selected to conduct the farmer
87 participatory research on organic farming. These villages were selected because of their
88 representativeness of respective agroclimatic zones, uniqueness in location (away from towns and nearer
89 to towns) and logistic considerations. Purposive selection of locations is a hallmark of FPR and this has
90 been practiced in different parts of the globe [17].

2.2 Identification of Major Farming Systems

Focus group discussion method was followed to identify the major farming systems present in the villages. A number of group meetings were conducted in different hamlets of the respective villages. After a long discussion with the villagers three major farming systems were identified from each village following the principles of manual discrimination [18].

Three farming systems each in Purulia and South 24 Parganas were identified. In village Kalla of Purulia district the following major farming systems were found - (a) Farming System-I comprising of two units viz. Agriculture and Cattle unit; (b) Farming System-II comprising of four units viz. Agriculture, Cattle, Poultry and Goatery unit and (c) System-III comprising of five units viz. Agriculture, Cattle, Poultry, Duck and Goatery unit (Table 2). In Paruldaha village of South 24 Parganas district the major farming systems were - (a) Farming System-I comprising of Agriculture, Cattle and Poultry unit; (b) Farming System-II comprising of Agriculture, Cattle, Goatery, Poultry and Fishery unit and (c) System-III comprising of Agriculture, Cattle, Goatery, Poultry, Duck and Fishery unit.

Comment [G. O.6]: What do you mean by Agriculture???

Table-2 Enterprises under different farming systems in studied locations

District	Major Farming Systems		Agriculture (acreage)	Cattle (Nos.)	Poultry (Nos.)	Goat (Nos.)	Duck (Nos.)	Fishery (acreage)
Purulia	FS –I	F-1	2.00	04	-	-	-	-
		F-2	2.14	03	-	-	-	-
		F-3	1.84	02	-	-	-	-
	FS –II	F-1	1.00	04	07	03	-	-
		F-2	2.00	03	11	03	-	-
		F-3	1.87	03	07	01	-	-
	FS –III	F-1	1.83	04	09	06	07	-
		F-2	1.77	04	10	04	08	-
		F-3	2.03	04	06	02	10	-
South 24Parganas	FS –I	F-1	2.64	04	10	-	-	-
		F-2	2.08	03	07	-	-	-

	F-3	0.66	02	10	-	-	-
FS –II	F-1	1.52	03	15	05	-	0.33
	F-2	2.00	03	07	04	-	0.08
	F-3	1.32	02	10	04	-	0.10
FS –III	F-1	0.41	04	06	08	01	0.09
	F-2	2.31	03	05	08	04	0.09
	F-3	0.38	04	05	05	05	0.10

105

106 2.3 Process of farmer selection

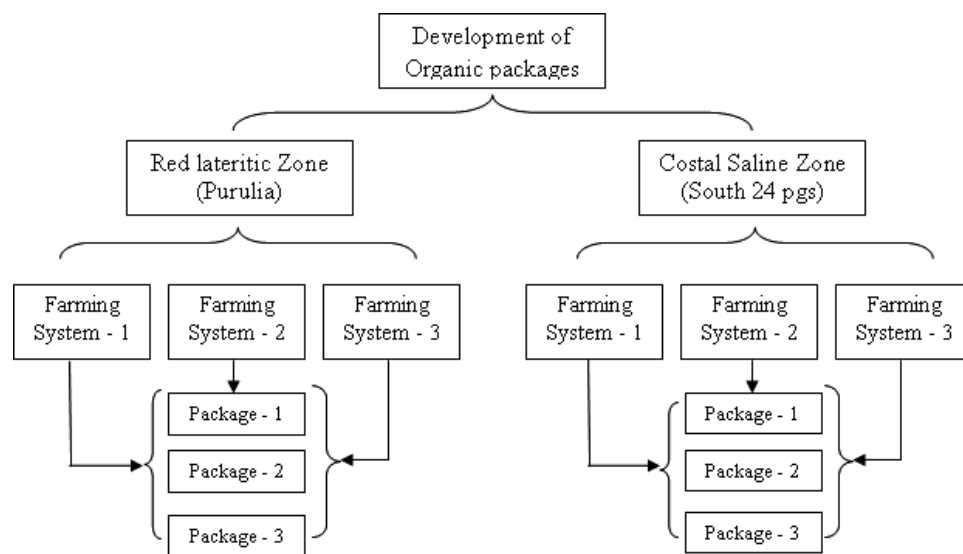
107 Three key decisions regarding sampling are important when using a participatory approach – (a) where to
 108 work (site selection), (b) who to work with (selection of participates), and (c) how to work with them [17]. A
 109 number of general village meetings were conducted in different hamlets of those villages wherein farmers
 110 gathered at a convenient time in a common place. The research purposes and objectives were discussed
 111 in the meeting thoroughly, and at the end, some farmers expressed their interest and agreed to take part
 112 in on-farm trial. Finally three farmers from each farming system i.e. nine farmers from each village were
 113 selected to develop new organic packages and their field trial [19]. Hence, there were three different
 114 packages were developed for three farmers under each farming system.

115 2.4 Determination of nutrient sources for organic farming

116 To determine the nutrient sources for organic farming the following steps were followed for a given
 117 farming system –

- 118 a) Assessment of organic nutrient sources available in different farming systems.
- 119 b) Nutrient analysis of the experimental soil was done.
- 120 c) Recommendation of nutrient for a particular crop from state department of agriculture was taken
 121 into consideration.
- 122 d) The recommended nutrients were supplied through the available nutrient sources in respective
 123 farming systems in consultation with the farmers.

124 Farmers identified three major farming systems in each agro-climatic zone and three willing farmers were
 125 selected under each farming system. Three different organic nutrient packages were developed for these
 126 three farmers under each farming system. Thus, nine packages were developed under each agro-climatic
 127 zone. The hierarchy of organic package development is given below through a diagram:



128 **Fig. 2. The scheme of sampling and outline of nutrient package development**

129 2.5 Description of nutrient packages

130 Three different packages were developed for three farmers under each farming system. Therefore, total
 131 nine organic packages were developed in a district for its three major farming systems. Two different
 132 modes of nutrient application viz. basal application through bulky manure and top-dressing through liquid
 133 manure were taken into consideration for development of organic packages –. Liquid manure contains
 134 cow dung, cow urine, agricultural/kitchen waste, water etc. and this was specially used to supply more
 135 efficient nutrients to the plants [20, 21, 22]. There is good evidence that foliar feeding of liquid manure can
 136 be 8 to 10 times more effective than soil feeding [23]. Some exciting findings of several studies have
 137 shown that foliar application of essential nutrients increased the yield of muskmelon [24, 25], maize [26],
 138 soybean [26, 27, 28] and peanuts [29] along with quality attributes. The proportion of bulky manure (farm
 139 yard manure or FYM) and liquid manure (Sasyagavya) in the organic package were also determined as

per the quantity of biomass available in the farming system. The proportion of bulky manure was higher than the liquid manure when the availability of organic materials in the farming system was more.

142

2.6 Method of Preparation of farm Yard Manure (FYM) and Sasyagavya

Cow Dung (1 part), cow urine (1 part), agricultural waste (1 part), rice boiled water / rice gruel (1 part), soil of cultivable land (1-2 hand full) and water (10 part) mixed together in a container and kept for 10-12 days for fermentation. The solution was stirred twice a day to ensure enhanced microbial activity. The container was covered with a locally available unused jute bag/cotton cloth so that the solution might come in contact with air easily.

FYM was prepared using cattle shed materials such as cow dung, straw, scattered excess food materials, and grasses. All the materials coming from cattle unit were put together in a pit under a shady place for 8-10 months for better fermentation. Then it was used as FYM in the agricultural field.

2.7 Identification of resources for preparing organic inputs -

Preparation of organic inputs was done based on the resource availability in the each and every farming system present in the villages. Mainly available animal/bird excreta and their urine were taken into consideration to develop the organic packages since these were the primary sources available with the farmers of the study locations.

Table 3a. Identification of resources for package development in Purulia district

Farming System	Package	Available Resources	Nutrient Management	
			Bulky Manure	Liquid Manure
Farming System-1	Package-1	Cattle Dung and Urine	FYM	Sasyagavya

	Package-2	Cattle Dung and Urine	FYM	Sasyagavya
	Package-3	Cattle Dung and Urine	FYM	Sasyagavya
	Package-1	Cattle Dung and Urine +Poultry and Goat Dung	FYM+Poultry Manure + Goat Manure	Sasyagavya
Farming System-2	Package-2	Cattle Dung and Urine +Poultry and Goat Dung	FYM+Poultry Manure + Goat Manure	Sasyagavya
	Package-3	Cattle Dung and Urine +Poultry and Goat Dung	FYM+Poultry Manure + Goat Manure	Sasyagavya
	Package-1	Cattle Dung and Urine +Poultry, Duck and Goat Dung	FYM+Poultry and Duck Manure + Goat Manure	Sasyagavya
Farming System-3	Package-2	Cattle Dung and Urine +Poultry, Duck and Goat Dung	FYM+Poultry and Duck Manure + Goat Manure	Sasyagavya
	Package-3	Cattle Dung and Urine +Poultry, Duck and Goat Dung	FYM+Poultry and Duck Manure + Goat Manure	Sasyagavya

158 Cattle Excreta– 5kg/day/cattle; Bird Excreta– 0.10kg/day/bird; Goat Excreta– 3kg/day/goat

159 **Table 3b. Identification of resources for package development in South 24 pgs District**

Farming System	Package	Available Resources	Nutrient Management	
			Bulky Manure	Liquid Manure
Farming System-1	Package-1	Cattle Dung and Urine + Poultry Manure	FYM	Sasyagavya

	Package-2	Cattle Dung and Urine + Poultry Manure	FYM	Sasyagavya
	Package-3	Cattle Dung and Urine + Poultry Manure	FYM	Sasyagavya
	Package-1	Cattle Dung and Urine + Poultry and Goat Dung	FYM+Poultry Manure + Goat Manure	Sasyagavya
Farming System-2	Package-2	Cattle Dung and Urine + Poultry and Goat Dung	FYM+Poultry Manure + Goat Manure	Sasyagavya
	Package-3	Cattle Dung and Urine + Poultry and Goat Dung	FYM+Poultry Manure + Goat Manure	Sasyagavya
	Package-1	Cattle Dung and Urine + Poultry, Duck and Goat Dung	FYM+Poultry and Duck Manure + Goat Manure	Sasyagavya
Farming System-3	Package-2	Cattle Dung and Urine + Poultry, Duck and Goat Dung	FYM+Poultry and Duck Manure + Goat Manure	Sasyagavya
	Package-3	Cattle Dung and Urine + Poultry, Duck and Goat Dung	FYM+Poultry and Duck Manure + Goat Manure	Sasyagavya

160 Cattle Excreta– 5kg/day/cattle; Bird Excreta– 0.10kg/day/bird; Goat Excreta– 3kg/day/goat

161 2.9 Soil nutrient analysis

162 The methods involved in analyses of soil samples are given in Table 4.

163 **Table 4. Methods of Soil Nutrient Analysis**

Chemical Properties of Soil	Method of Analysis
Soil Nitrogen Analysis	A rapid procedure for estimation of available nitrogen in soils. [30]

Soil Phosphorus Analysis	Estimation of available phosphorus in soils by extraction with sodium bicarbonate. [31]
Soil Potassium Analysis	Flame Photometer
Organic Carbon Analysis	An examination of the Degtjareff method for determining soil organic matter, and a proposed modification of the chromic acid titration method. [32]
pH and EC	Soil survey laboratory methods manual. [33]

164

165 3. RESULTS AND DISCUSSION

166 3.1 Analysis of Soil Nutrients

167 Initial soil nutrients status of experimental plots were analyzed by standard methods (Table 4). From the
 168 results (Table 5) it is clear that the soils of Purulia and South 24 Parganas district are acidic and neutral to
 169 slight alkaline in nature, respectively. Variation in organic matter content between soils of two study
 170 locations was remarkable.

171 **Table 5. Soil Health Report for two study locations**

District	Major Farming Systems	pH	EC (dS/m)	Organic	Total N	Available	Available	
				carbon		P ₂ O ₅	K ₂ O	
				(%)	(%)	(kg/ha)	(kg/ha)	
Purulia	I-ST	F-1	5.06	0.13	0.41	0.030	74.9	127.9
		F-2	4.68	0.17	0.36	0.029	83.1	154.6
		F-3	5.23	0.14	0.50	0.030	67.8	169.4
	II-ST	F-1	5.46	0.15	0.57	0.026	74.9	142.8
		F-2	5.52	0.17	0.48	0.028	90.4	149.7

Comment [G. 0.8]: Convert to kg/ha

Comment [G. 0.7]: Convert to kg/ha

South 24 Parganas	FS – II	F-3	5.78	0.14	0.52	0.025	76.2	139.7
		F-1	4.99	0.15	0.47	0.028	84.9	159.5
		F-2	5.23	0.15	0.37	0.026	78.2	142.1
		F-3	4.78	0.16	0.47	0.026	67.2	132.7
	FS – I	F-1	6.73	0.66	0.41	0.056	65.7	188.7
		F-2	7.10	0.57	0.46	0.060	68.5	193.0
		F-3	6.91	0.62	0.33	0.062	74.4	203.3
	FS – II	F-1	7.39	0.61	0.39	0.049	67.0	185.7
		F-2	7.59	0.62	0.43	0.052	69.4	189.3
		F-3	7.37	0.64	0.33	0.055	64.0	183.8
	FS – II	F-1	7.05	0.60	0.38	0.065	66.0	186.9
		F-2	6.98	0.61	0.44	0.063	69.0	189.6
		F-3	7.22	0.64	0.33	0.060	66.3	185.3

172 FS- Farming System; F- Farmer

173

174 3.2 Nutrient content in different organic sources

175 The nutrient content in the organic sources (Table 6) used for the study, is important because the
 176 appropriate nutrient needed for a given crop will be dependent on the crop specific recommendation of
 177 the state department of Agriculture , the amount of nutrient present in the inputs and nutrient status of the
 178 selected soil.

179 **Table 6. Nutrients present in different organic sources**

Organic sources	N%	P%	K%
FYM	0.75	0.2	0.5
Poultry Manure	3.03	0.63	1.4
Goat Manure	3.0	1.0	2.0
Vermicompost	3.0	1.0	1.5
Sasygavya* (Liquid Manure)	0.083	0.013	0.113

180

181 3.3 Recommended nutritional doses for different crops:

182 The nutritional demand varies from one crop to another and nutrient recommendation is made to supply
 183 nutrients as per the crop's demand. The State Department of Agriculture's recommended doses of
 184 N:P₂O₅:K₂O for different crops [34] was applied (Table 7).

185

186 **Table 7. Recommended nutritional doses for different crops**

Crop	N : P ₂ O ₅ : K ₂ O (kg/ha)
Paddy*	80 : 40 : 40
Greengram*	10-15 : 40
Chilli**	120 : 60 : 50
Bitter gourd**	20 : 30 : 30
French bean**	40 : 60 : 50

187

188 **3.4 Sourcing plant nutrients and development of nutrient packages:**

189 Based on the recommendation of the State Department of Agriculture, plant nutrients were chosen
 190 through different resources (both bulky manure and liquid manure) available in the farming systems. The
 191 proportion of bulky manure and liquid manure in the organic package was determined by the quantity of
 192 identified resources available in the respective farming systems and it was finalized in participation with
 193 selected farmers. Bulky manure and liquid manure were applied as basal dose and foliar spray,
 194 respectively. The determined proportion of bulky manure and liquid manure in the different packages are
 195 given in Tables 8a and 8b respectively. In Farming System-1 of Purulia district three different packages
 196 were suggested: under Package-1 highest quantity of organic resources was made available, followed by
 197 Package-2 and Package-3. As Package – 1 had highest quantity of bulky manure (i.e. 20 kg/day), 80% of
 198 total nutrient requirement was sourced by bulky manure and rest 20% was sourced by liquid manure
 199 (through Shasyagavya). In package-2 and Package-3 these percentages were 75% and 70% of total
 200 nutrient requirement, and these were sourced by bulky manure; rest 25% and 30% were sourced by liquid
 201 manure. The same logic was applied for all other farming systems under the study areas. After getting a

202 collaborative discussion with the farmers it was decided that the highest quantity of resources available in
 203 the identified farming system will be the Package-1, followed by Package-2 and Package-3.

204 **Table 8a. Sourcing of nutrients through available resources in the farming system in Purulia**

205 **district**

Farming System	Pack age	Available Resources		Nutrient Management	
		Sources	Quantity/day	Bulky Manure	Liquid
		(Name and Number)	(in kg)		Manure
Farming System-1	Package-1	Cattle Dung and Urine		FYM	Sasyagavya
		No. of Cattle- 04	20*	(80 %)	(20%)
	Package-2	Cattle Dung and Urine		FYM	Sasyagavya
		No. of Cattle- 03	15	(75 %)	(25%)
	Package-3	Cattle Dung and Urine		FYM	Sasyagavya
		No. of Cattle- 02	10	(70 %)	(30%)
	Package-1	Cattle Dung and Urine +Poultry* and Goat Dung*		FYM+Poultry Manure + Goat Manure	Sasyagavya
		No. of Cattle – 04	20+0.7+9 =29.7	(80 %)	(20%)
		No. of Poultry – 07			
		No. of Goat – 03			
Farming System-2	Package-2	Cattle Dung and Urine +Poultry and Goat Dung		FYM+Poultry Manure + Goat Manure	Sasyagavya
		No. of Cattle – 03	15+1.1+9 =25.1	(75 %)	(25%)
		No. of Poultry – 11			
		No. of Goat – 03			

Farming System-3	Package-3	Cattle Dung and Urine +Poultry and Goat Dung			FYM+Poultry Manure + Goat Manure (70 %)	Sasyagavya (30%)
		No. of Cattle – 03	15+0.7+3			
		No. of Poultry – 07	= 18.7			
		No. of Goat – 01				
	Package-1	Cattle Dung and Urine +Poultry, Duck and Goat Dung			FYM+Poultry and Duck Manure + Goat Manure (80 %)	Sasyagavya (20%)
		No. of Cattle – 04	20+0.9+0.7+18			
		No. of Poultry – 09	= 39.6			
		No. of Duck – 07				
		No. of Goat – 06				
	Package-2	Cattle Dung and Urine +Poultry, Duck and Goat Dung			FYM+Poultry and Duck Manure + Goat Manure (75 %)	Sasyagavya (25%)
		No. of Cattle – 04	20+1+0.8+12			
		No. of Poultry – 10	=33.8			
		No. of Duck – 08				
		No. of Goat – 04				
	Package-3	Cattle Dung and Urine +Poultry, Duck and Goat Dung			FYM+Poultry and Duck Manure + Goat Manure (70 %)	Sasyagavya (30%)
		No. of Cattle – 04	20+0.6+1+6			
		No. of Poultry – 06	=27.6			
		No. of Duck – 10				
		No. of Goat – 02				

206 *Cattle Excreta– 5kg/day/cattle; Bird Excreta– 0.10kg/day/bird; Goat Excreta– 3kg/day/goat

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208

209

210 **Table 8b. Sourcing of nutrients through available resources in the farming system in South 24**

211

Parganas district					
Farming	Pack	Available Resources		Nutrient Management	
System	age	Sources	Qty/day	Bulky Manure	Liquid
		(Name and Number)	(in kg)		Manure
Farming System-1	Package-1	Cattle Dung* and Urine		FYM	Sasyagavya
		No. of Cattle- 04	20+1=21	(80 %)	(20%)
		No. of Poultry Bird- 10			
	Package-2	Cattle Dung and Urine+ Poultry		FYM	Sasyagavya
		Manure*	15+0.7= 15.7	(75 %)	(25%)
		No. of Cattle- 03			
	Package-3	No. of Poultry Bird- 07			
		Cattle Dung and Urine		FYM	Sasyagavya
		No. of Cattle- 02	10+1=11	(70 %)	(30%)
		No. of Poultry Bird- 10			
Farming System-2	Package-1	Cattle Dung and Urine +Poultry		FYM+Poultry Manure	Sasyagavya
		and Goat Dung*	15+1.5+12	+ Goat Manure	(20%)
		No. of Cattle – 03	=31.5	(80 %)	
		No. of Poultry – 15			
	Package-2	No. of Goat – 05			
		Cattle Dung and Urine +Poultry		FYM+Poultry Manure	Sasyagavya
		and Goat Dung	15+0.7+12	+ Goat Manure	(25%)
		No. of Cattle – 03	=27.7	(75 %)	
		No. of Poultry – 07			
		No. of Goat – 04			

Farming System-3	Package-3	Cattle Dung and Urine +Poultry and Goat Dung			FYM+Poultry Manure + Goat Manure (70 %)	Sasyagavya (30%)
		No. of Cattle – 02	10+1+12			
		No. of Poultry – 10	= 23.0			
		No. of Goat – 04				
	Package-1	Cattle Dung and Urine +Poultry, Duck and Goat Dung			FYM+Poultry and Duck Manure + Goat Manure (80 %)	Sasyagavya (20%)
		No. of Cattle – 04	20+0.6+0.1+24			
		No. of Poultry – 06	= 44.7			
		No. of Duck – 01				
		No. of Goat – 08				
	Package-2	Cattle Dung and Urine +Poultry, Duck and Goat Dung			FYM+Poultry and Duck Manure + Goat Manure (75 %)	Sasyagavya (25%)
		No. of Cattle – 03	15+0.5+0.4+24			
		No. of Poultry – 05	=39.9			
		No. of Duck – 04				
		No. of Goat – 08				
	Package-3	Cattle Dung and Urine +Poultry, Duck and Goat Dung			FYM+Poultry and Duck Manure + Goat Manure (70 %)	Sasyagavya (30%)
		No. of Cattle – 04	20+0.5+0.5+15			
		No. of Poultry – 05	=36.0			
		No. of Duck – 05				
		No. of Goat – 05				

212 *Cattle Excreta– 5kg/day/cattle; Bird Excreta– 0.10kg/day/bird; Goat Excreta– 3kg/day/goat

213 4. CONCLUSION

214 The present study has shown the methodological outline of developing location-specific organic nutrient
 215 management packages for different crops under farming systems following the principles of farmer
 216 participatory research (FPR). After identification of farming systems and their quantum of availability of

resources , the amount of applied nutrient of specific crops are to be calculated through nutrient content in farm resources nutrient content of the soil and nutrient recommendation for the crops. Farmers themselves participated in the research to source plant nutrients based on available farm resources. This process may be used in the FPR projects working towards development of appropriate nutrient management practiced for organic growers. The identified organic nutrient management practice may now be conceptualized as treatments for "On-farm agronomic trials" to assess the impact of FPR on crop yield and profitability, besides many social and ecological benefits.

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