

A Crop Plan for Rice Fallow Cropping System in Dorika Watershed of Assam, India

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ABSTRACT: A study was conducted to prepare crop diversification plan for rice fallow cropping system in Dorika watershed of Sivasagar District in Assam based on soil site suitability evaluation of crops. The area coverage of this watershed comprises between 26°48' to 27°03' N latitude and 94°27' to 94°52' E longitude. The watershed boundaries were delineated based on Survey of India toposheet (1:50,000) no. 83J/13, 83J/9, 83J/12, and 83J/8. Generally, the soils under this watershed were found to be strongly acidic, high organic carbon content, low in CEC, medium to high base saturation and texture varies from coarse to fine texture. Soil pH, Drainage and nutrient constraints were the limiting factors for potential utilization of the land resources. Soil site suitability of crops was evaluated for crops such as rice, wheat, maize, mustard, potato, pea etc. Several crops are recommended depending on their suitability for the post rainy season in the soils which are kept fallow in the present land use system. Rice is the main crop under this watershed and cultivated during the rainy season due to imperfect drainage though the soils are moderately and marginally suitable. Potato is suitable for almost all the soils in the post rainy season. Mustard was also suggested by using proper management practices. Results of this study revealed that the study area under rice fallow cropping system could be modified into double cropping system with the use of proper fertility management and life saving irrigation.

Key words: Watershed, Soil site suitability, Crop diversification.

Sivasagar district of Assam occupies an area of 2,66,800 ha constituting 3.40 per cent of the states geographical area [Dutta, 1]. Dorika is one of the major rivers in Sivasagar district. Dorika watershed covers an area of 29,015 ha. Most of the cultivated areas under this watershed remain inundated for most part of the rainy season. Rice is cultivated during the rainy season and thereafter most of the cultivable lands remain fallow. A critical appraisal of land resources and then allocating them to the various cropping system in both rainy and post rainy seasons based on their potential will improve the cropping intensity and compensate the crop loss suffered during rains and floods [Vadivelu *et.al.*, 2]. In such attempts the soil maps prepared with sufficient ground truth play a vital role in fitting the site specific cultivation. Therefore, the present investigation was taken up to evaluate the soils of Dorika watershed for growing various crops, particularly introducing cultivation of some important crops during rabi season in the dominantly rice alone cropping system.

MATERIALS AND METHODS

Site description

The Dorika watershed of Sivasagar district is a part of the Upper Brahmaputra Valley Zone of Assam. This watershed is situated between and 26°48' to 27°03' N latitude and 94°27' to 94°52' E longitude. This watershed has an area of 29,015 ha comprising topography of hill to alluvial plain.

Physiography and Geology

The watershed area represents the plains of the Brahmaputra valley. The alluvium deposited at the foothill slopes forming the piedmonts. Geology of the area is alluvium of Pleistocene (Wadia, 4) and recent periods in the plains and tertiary sedimentary rocks in the hill. Some areas in southern side of this watershed have low hills in continuation of the Naga Hills.

Climate

The climate of this area is humid subtropical with an average annual rainfall of 2,334 mm. The soil moisture

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of this study area is Udic and the soil temperature regime is hyperthermic.

Flooding and drainage

The northern part of this watershed particularly along the river Brahmaputra is often subjected to flooding during the rainy season. The rest of the watershed is often remaining under inundation for the most part of the rainy season. The drainage condition is poor during and immediately after flooding.

Delineation of Dorika watershed

The boundary of Dorika watershed is delineated based on Survey of India toposheet No. 83J/13, J/9; 83I/12 and I/8 (Figure 1) and IRS, R-2, L-4MX remote sensing data (1:50,000 scale) were visually interpreted for physiographic delineation of Dorika watershed comprising with drainage network.

Soil site suitability evaluation of crops

The suitability of the soils for growing rice, wheat, maize, mustard, potato, banana and tea was evaluated following the method proposed by [Sys *et al.*, 3]. The soil characteristics were matched with the requirements of the crops at different limitation levels. The suitability classes and subclasses were decided by most limiting soil characteristics. After the evaluation, the soil units

comprising two or more soil series were allotted to these crops for which they are highly suitable (S1) and moderately suitable (S2). The crops which were in association with marginally suitable (S3) and presently not suitable (N1) classes are not recommended because their cultivation will not be economical. Thus, the site specific cropping plan was prepared for identified location of Dorika watershed based on soil characteristics and limitation of soil site suitability.

RESULTS AND DISCUSSION

Soils

Eleven soil site locations were identified under this watershed. The texture of the soils varies from sandy loam to clay loam or silty clay to clay in texture (Table 1). The soils of Banmukh and Panbecha which situated in northern side of river Dorika are silty loam in texture. Whereas the soils of Santak are the southeastern part of this watershed lies near the Naga hills and texture varies from sandy loam to loamy sand. Soil pH is ranges from 4.48 to 5.81. The organic carbon content is varies from 0.66 to 1.2 %. The base saturation of the soils is less than 50% in Santak, Lunpuria, Abhaypuria, Chengmoigaon, Hatimuria, Dorikapar, Chengalibari, Panbecha and Katanipar satra. But in Charaideo and Banmukh the base saturation is found to be 69.2 and

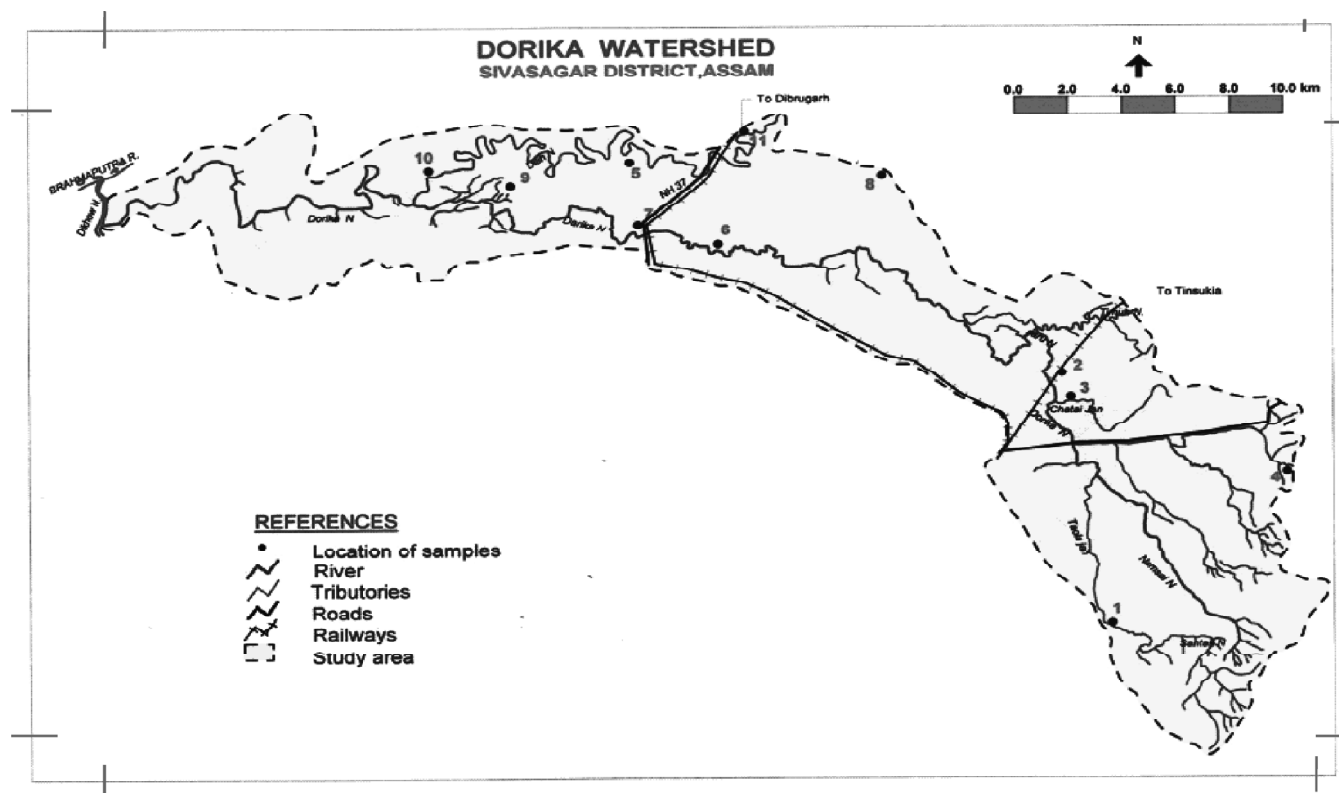


Figure 1: Delineation of Dorika watershed

Table 1
Some physico chemical properties of soils of Dorika watershed of Sivasagar district

Location no	Soil site location	Textural sequence upto 100 cm (%)	Sand (%)	Silt (%)	Clay (%)	pH:2.5	Org.C (%)	CEC (Cmol p ⁺ kg ⁻¹)	BS(%)
1	Santak	sl, l, sl, sl	72.3	12.5	15.2	5.31	0.84	9.14	47.00
2	Lunpuria	cl, cl, l	28.4	40.1	31.5	4.48	0.78	10.95	38.80
3	Abhaypuria	cl, l,cl	30.0	38.8	31.2	4.93	1.21	11.12	48.71
4	Charaideo	sl, l, l, sl	70.5	11.3	18.2	5.81	1.20	8.61	69.20
5	Chengmoigaon	sic, sil, c, cl	20.5	38.1	41.6	5.22	1.02	13.3	46.17
6	Hatimuria	sic, sil, cl, c	12.6	45.4	42.0	5.15	0.91	13.9	42.51
7	Dorikapar	cl, l, cl	26.3	43.4	30.3	5.4	0.99	14.3	44.50
8	Chengalibari	sic, sic, cl	30.0	18.6	51.4	5.19	1.14	14.9	45.20
9	Banmukh	sil, sic, sl	28.9	45.8	25.3	5.21	0.66	11.3	60.70
10	Panbecha	sil, l, sl	26.5	49.9	23.6	5.16	0.76	12.12	36.60
11	Katanipar satra	sil, sic, c, cl	36.1	47.2	16.7	5.21	1.12	12.6	46.40

sandy loam- sl, clay loam-cl, silty clay-sic, clay-c, silt loam-sil, loam-l.

Table 2
Suitability class of the soils of Dorika Watershed of Sivasagar District

Location no	Soil site Location	Rice	Wheat	Maize	Mustard	Potato	Tea	Banana
1	Santak	S3 sf	S3 fs	S3 sf	S3 f	S3 f	S2 f	N1 sf
2	Lunpuria	S2 f	S3 f	S3 f	S3 fs	S3 sf	S2 lw	S3 f
3	Abhaypuria	S2 f	S3 f	S3 f	S3 fs	S3 sf	S2lw	S3 f
4	Charaideo	S3 s	S3 sf	S3 s	S2 f	S1	S2 f	S3 sf
5	Chengmoigaon	S2 f	S3 sf	S3 sf	S3 fs	N1sf	S3 sf,	N1 sf
6	Hatimuria	S2 f	S3 sf	S3 sf	S3 fs	N1sf	S3 sf,	N1sf
7	Dorikapar	S2 f	S3 f	S3 f	S3 fs	S3 sf	S2 f	S2f
8	Chengalibari	S2 f	S3 fs	S3 sf	N1 fs	N1f	S3sw	S3sf
9	Banmukh	S2 sf	S3 f	S3 wf	S3 f	S3 sf,	N1	S3sf,w
10	Panbecha	S2 sf	S3 f	S3wf	S3 f	S3 sf	N1	S3sf,w
11	Katanipar satra	S2 sf	S3 f	S3 f	S3 f	S3 sf	S2 lf	S3sf

Soil pH-f, soil texture-s, drainage-w, base saturation-l

Table 2
Modified Suitability classes of Dorika Watershed

Locationno	Soil site Location	Rice	Mustard	Potato	Tea	Banana
1	Santak	S2	S2	S2	S1	N1
2	Lunpuria	S1	S3	S3	S2	S2
3	Abhaypuria	S1	S3	S3	S2	S2
4	Charaideo	S2	S2	S1	S1	S3
5	Chengmoigaon	S1	S3	N1	S3	N1
6	Hatimuria	S1	S3	N1	S3	N1
7	Dorikapar	S1	S3	S3	S1	S1
8	Chengalibari	S1	N1	N1	S3	S3
9	Banmukh	S2	S2	S3	N1	S3
10	Panbecha	S2	S2	S3	N1	S3
11	Katanipar satra	S2	S2	S3	S2	S3

60.7% respectively. The cation exchange capacity of the soils under Dorika watershed is ranges between 9.14 to 14.9 cmol(p⁺) kg⁻¹.

Rice

Rice is grown on all eleven cultivated soils during the rainy season between May to November. During this period, 2138.8 mm annual rainfall is received. The drainage condition remains imperfect or poor due to

shallow water table and therefore, only rice can be cultivated during the rainy season. All soils under this watershed were found to be moderately suitable for rice (Table 2). But, the soils of Santak and Charaideo were found to be marginally suitable. pH and Soil texture denoted as(s) and Soil pH denoted as (f) are the major limitation. Liming and addition of organic manure or growing green manure crops will improve the suitability of these soils for rice.

Table 3
Crop diversification plan for Dorika watershed

Location no	Soil site Location	Rainy season	Post harvest rainy season	Year round plantation/horticultural crops
1	Santak	Rice	Potato, maize, pea	Tea
2	Lunpuria	Rice	French bean, pea	Tea
3	Abhaypuria	Rice	French bean, pea	Tea, banana
4	Charaideo	Rice	Potato, pea, mustard, , maize	Tea
5	Chengmoigaon	Rice	Mustard	Banana
6	Hatimuria	Rice	Rice	Banana
7	Dorikapar	Rice	Maize	Tea, Banana
8	Chengalibari	Rice	Rice	—
9	Banmukh	Rice	Green gram, pea	Arecanut,
10	Panbecha	Rice	Green gram, pea	Arecanut
11	Katanipar satra	Rice	Gram, pea	Arecanut

Wheat

Though the climatic condition is suitable for wheat but low precipitation in early crop growth period and unprecedented rainfall during the month of March and April coinciding for wheat maturity was a serious limitation in this study area of the state.

The soils of study area are marginally suitable (S3) due to lower pH and low precipitation.

Maize

Maize is acid sensitive and therefore eight soil sited area are marginally suitable (S3) to presently not suitable (N1) due to strong acidity and low precipitation. Drainage is another constraint in the soils for maize cultivation.

Oilseed crops

For mustard, the soils of Charaideo is moderately suitable (S2) and except Chengalibari other soil series are marginally suitable (S3). The soils of Chengalibari is presently not suitable (N1) for cultivation of Mustard due to presence of high per cent of clay and low pH.

Vegetable crops

Potato is highly suitable (S1) in Charaideo but in other soil sites are found to be marginally suitable (S3) to unsuitable with pH and texture is the major constraints.

Horticultural crops

Soil site suitability for horticultural crops was also evaluated. Banana is moderately suitable (S2) in Dorikapar. The soils of Lunpuria, Abhaypuria, Charaideo, Chengalibari, Banmukh and Panbecha were found to be marginally suitable (S3) whereas the soils of Santak, Chengmoigaon and Hatimuria gaon were presently not suitable (N1) for cultivation of

Banana. The soil texture, pH and drainage are the major limitations.

Plantation crops

The soils of Charaideo and Santak are presently under tea cultivation. Soil site suitability criteria for tea were evaluated. Soils of Charaideo, santak, Lunpuria, Abhaypuria Dorikapar and Katanipar satra are moderately suitable (S2). The remaining others are marginally suitable (S3) with soil limitations of organic matter, texture, pH and Drainage (*w*).

Crop diversification plan

During the rainy season between May and September, the soils have a poor drainage environment. The water table also fluctuates within one meter of the soil surface. Therefore, during this season, the options are limited and only rice can be grown profitably. The soil site suitability parameters resulted that the soils of Dorika watershed not equally suitable for all crops due to different limitations. The major limitations of these soils lie in the physical properties (texture), acidity, fertility, low CEC, base saturation, and poor drainage. The acidity and fertility status can be increased by use of liming, organic manure and green manure. On the basis of limitation and soil site suitability criteria site specific cropping plan was prepared for post harvest rainy season (Table 3). Various cropping system like Rice-mustard, rice-potato, rice-rice can be adopted in the study area.

CONCLUSION

The area experiences sufficient rainfall with length of growing period of 290 days and optimum temperatures suitable for a number of crops. But, pH, drainage, physical texture, nutrient constraints become the limiting factors for potential utilization

of the land resources. Some agricultural crops like potato, mustard, maize, pea, green gram, French bean can be grown in these soils with liming and fertilizer management. Beside this, the water stored in the soils is in appreciable amount which can be utilized for intensification during Rabi under rainfed condition. The water stored in the ponds can be utilized for life saving irrigation during critical periods particularly for growing wheat and potato. Thus, with judicious rain water and soil fertility management may increase the cropping intensity of this watershed.

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