domains: Potential for up-scaling

P Parthasarathy Rao, S Bhagavatula, G Basavaraj
Ch Ravinder Reddy and Belum VS Reddy

I. Introdution

Sweet sorghum cultivation as part of the NAIP-ICAR sub-project on the sweet sorghum to ethanol value chain was being pilot tested in Medak district of Andhra Pradesh (Map 1). Preliminary analysis of farm-level data from the project sites indicate that sweet sorghum is a commercially viable crop and is able to compete with other dryland crops such as grain sorghum, sorghum and pigeonpea intercrop and maize. One of the challenges before and after the completion of the project is up-scaling of sweet sorghum production to larger areas to make a viable alternative complement as feedstock for ethanol production. In this chapter we examine potential areas where sweet sorghum cultivation can be taken up in India. This is of course, subject to the establishment of a distillery in close proximity (50-100 kms from the farms).

II. Methodlogy Selection

In order to select appropriate sites for up-scaling sweet sorghum cultivation in India, meso-level district data, and expert opinions from crop scientists and extension agents were used. Geographically, the Deccan Plateau and the Eastern Ghats were selected as a suitable starting point as this region is the main sorghum growing region in the country and has a large area under rainfed crops. Eleven sub-regions were chosen based on shared common agro-ecological characteristics which would enable the easy location of the growing domains with the greatest potential for growing sweet sorghum. The coastal sub-regions were not considered as these typically had high rainfall and high irrigation potential, and therefore more suitable for high value crops. The agro-ecological zones are grouped using dominant soil types, climate, length of the growing period, normal rainfall and soil fertility (Table 1 and Map 2). In addition, the percentage of land under rainy season and postrainy season sorghum were also calculated to identify sub-regions which were already growing sorghum.

III. Potential domains for Cultivation

Of the eleven agro-ecological sub-regions, five were considered to be potential sweet sorghum growing areas. These are 6.1, 6.2, 6.3, 6.4 and 7.2. These sub-regions are mainly semi-arid environments (moist or dry) with the exception of 6.4 which is sub-humid (moist). Additionally these regions had more than 10% of the cropped area under either postrainy season or rainy season sorghum. The one exception to this was 7.2 that has a very low area under the crop (3% under rainy season sorghum and 1.5% under postrainy season sorghum), but this sub-region was selected as there are already other sweet sorghum for ethanol projects underway in this region. There is much variation between the sub-regions based on demographic criteria. With the exception of 6.4, all the sub-regions are predominantly rural with the population density ranging from 2.5 to 5.3 per ha (Table 2). In sub-regions 6.1, 6.2 and 6.4, the proportion of cultivators is higher whereas in 6.3 and 7.4, agricultural laborers form a bulk of the rural population. Three out of the five sub-regions show relatively low mechanization. The use of pump sets is also relatively low with diesel pump sets being the majority. Fertilizer application in the sub-regions is above 125 kg ha^{-1} but most of the fertilizer is being used on crops like fine cereals, cotton, vegetables and fruit crops. The fertilizer application for sweet sorghum as required under the improved package of practices is thus not perceived to be a stumbling block.

Map 1. Districts currently selected for sweet sorghum-ethanol value chain.

Table 1. Agro-ecological characteristics of selected AEZ for up-scaling sweet sorghum.

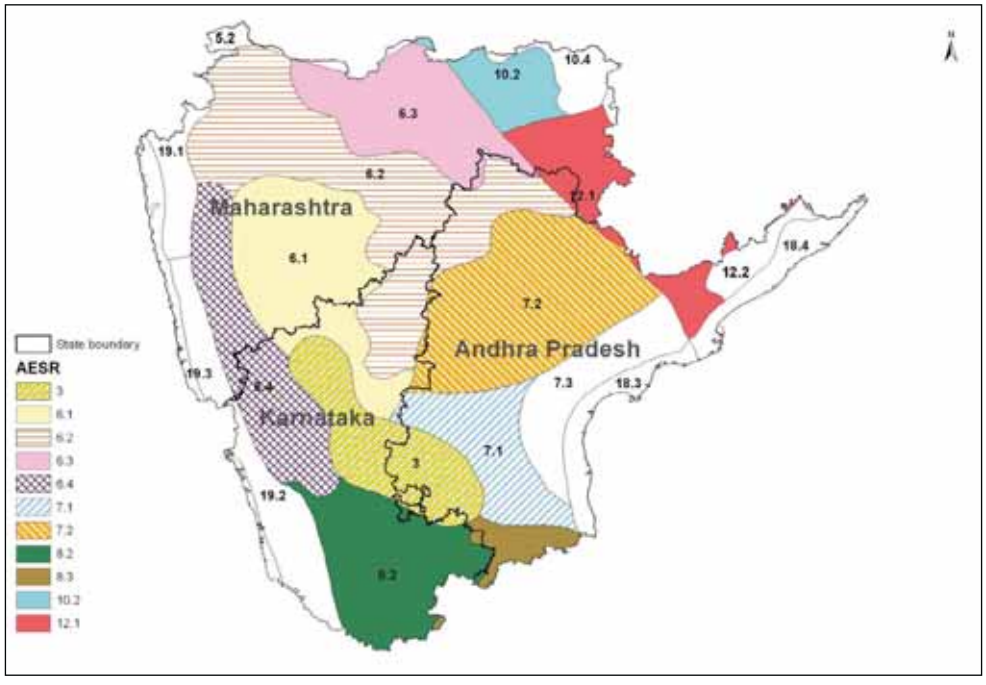
AEZ sub-region	Physiographic	Number of districts	Soil	Climate	Growing season (days)	Normal rainfall (mm)	Soil quality	Soil depth	Soil texture	Rainy season sorghum area ('000 ha)	Postrainy season sorghum area ('000 ha)
3	Deccan Plateau	5	Mixed red and black	Arid (typic)	60-90	592	Low to medium; 50-150 mm	Deep	Loamy and clayey	102.03 (5.23)*	209.62 (8.62)
6.1	Deccan Plateau	8	Shallow black (with medium and deep black soils as inclusion)	Semi-arid (dry)	90-120	686	Medium to high; 100-200 mm	Shallow and medium	Loamy	219.15 (2.58)	2499.30 (25.53)
6.2	Deccan Plateau	13	Shallow black (with medium and deep black soils as inclusion)	Semi-arid (moist)	120-150	885	Medium to high; 100-200 mm	Shallow and medium	Loamy: clayey 15-<35%	569.78 (8.02)	1325.05 (10.31)
6.3	Deccan Plateau	6	Deep black (with shallow and medium black soils as inclusion)	Semi-arid (moist)	120-150	935	Medium to high; 100-200 mm	Shallow	Loamy: clayey 15-<35%	452.70 (15.94)	46.70 (1.40)
6.4	Deccan Plateau	9	Shallow black (with medium and deep black soils as inclusion)	Sub-humid (dry)	150-180	1079	Medium to high; 100-200 mm	Shallow	Loamy: clayey 15 -<35%	164.17 (5.37)	766.54 (9.92)

Table 1. Agro-ecological characteristics of selected AEZ for up-scaling sweet sorghum.

AEZ sub-region	Physiographic	Number of districts	Soil	Climate	Growing season (days)	Normal rainfall (mm)	Soil quality	Soil depth	Soil texture	Rainy season sorghum area ('000 ha)	Postrainy season sorghum area ('000 ha)
7.1	Deccan Plateau	2	Mixed red and black	Semi-arid (dry)	90-120	677	Medium 100-150 mm	Shallow and medium	Loamy: clayey 15 -<35%	6.01 (1.29)	68.85 (9.40)
7.2	Deccan Plateau	8	Mixed red and black	Semi-arid (moist)	120-150	860	Medium to very high; 100-150;>200 mm	Deep	Loamy: clayey 15 - <35%	102.85 (2.91)	64.36 (1.52)
8.2	Deccan Plateau	10	Red loamy	Semi-arid (moist)	120-150	954	Low; 50-100 mm	Medium to deep	Loamy	56.74 (1.77)	15.56 (0.47)
8.3	Eastern Ghats & Tamil Nadu Uplands	1	Red loamy	Semi-arid (moist)	120-150	697	Low; 50-100 mm	Deep	Loamy	1.22 (0.23)	0.00 (0.00)
10.2	Deccan Plateau	2	Shallow black (with medium and deep black soils as inclusion)	Sub-humid (dry)	150-180	1193	Medium to high; 100-200 mm	Shallow and medium	Loamy: clayey 15 - <35%	32.50 (2.99)	3.90 (0.17)
12.1	Eastern Plateau	2	Red and lateritic	Sub-humid (moist)	180-210	1524	Low to medium; 50-150 mm	Deep	Loamy	7.00 (1.18)	19.10 (1.47)

Note: Rows highlighted are the selected sub-regions suitable for up-scaling.

*Figures in parenthesis indicates percent sorghum area to gross cropped area of the sub-region.



Map 2. Agro-ecological zones for up scaling sweet sorghum.

Table 2. Demographic characteristics of the selected agro-ecological zones.

AEZ sub-region	Total population ('000)	% Rural population	Proportion of cultivators (%)	Proportion of agricultural laborers (%)	Rural literacy (%)	Rural population density (number per ha)	Tractors (number per 100 sq km)	Diesel pumpsets (number per 100 sq km)	Electric pumpsets (number per 100 sq km)	Fertilizer consumption (kg ha^{-1})
6.1	24,839	67	24	17	58	2.6	0.6	6.6	0.6	131
6.2	32,191	73	21	19	52	2.9	0.4	6.6	0.6	138
6.3	13,622	73	15	28	64	2.5	0.4	3.8	0.5	125
6.4	35,462	42	24	16	59	3.5	1.6	6.4	0.9	164
7.2	25,874	67	16	23	43	5.3	1.9	27.1	1.2	269

Table 3. Cropping pattern in the selected agro-ecological sub regions.

AEZ sub-region	NCA ('000 ha)	% Irrigated land	Cropping intensity (%)	Fine cereals (% of GCA)	Coarse cereals (% of GCA)	Pulses (% of GCA)	Oilseeds (% of GCA)	Sugarcane (% of GCA)	Cotton (% of GCA)	Others (% of GCA)
6.1	6,386	25	122	10	48	15	14	8	3	2
6.2	7,998	18	128	9	31	24	15	5	15	2
6.3	3,931	8	130	6	14	27	23	1	29	0
6.4	4,206	31	118	14	37	12	15	10	5	7
7.2	3,282	46	119	8	18	14	12	2	16	29

Cropping pattern

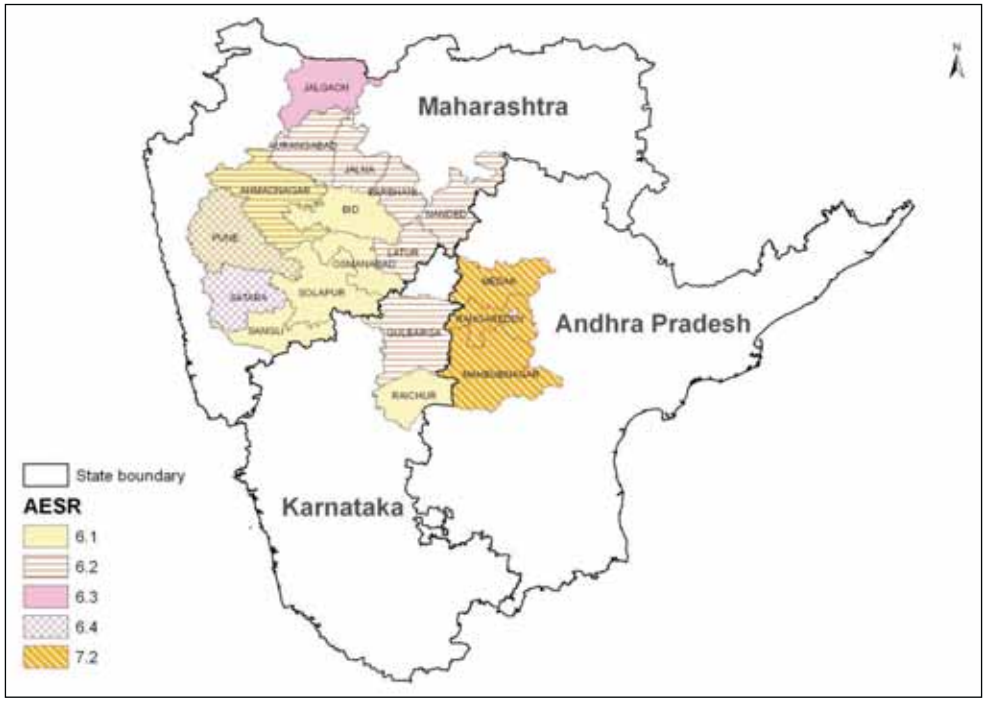
Sub-region 6.2 has the largest net cropped area among the five selected sub-regions (Table 3). The proportion of irrigated land varies widely between the sub-regions, ranging from 8% to 46%. Cropping intensity is relatively high in all the sub-regions. Coarse cereals dominate the cropping pattern of the sub-regions, the only exception being 6.3 where other rainfed crops such as pulses, oilseeds and cotton form the bulk of crops. Pulses are the second-most important crops planted in the sub-regions.

The agro-ecological sub-regions cover a large geographical area and are very diverse in their characteristics. Hence to better target sweet sorghum, the data on districts within each agro-ecological zone was also collected and analyzed. Based on this, eighteen potential districts were selected in the five agro-ecological zones. The details are given in Table 4. The majority of these districts fall in Maharashtra with two in northern Karnataka and three in Andhra Pradesh (Map 3). All the selected districts have over 50,000 ha under sorghum as on 2007 and are potential areas for the first phase of up-scaling sweet sorghum.

Table 4. AEZs and districts within the AEZs for upscaling sweet sorghum.

Agro-ecological sub-region	District
6.1	Raichur*
6.1, 6.2	Ahmednagar
6.1, 6.4	Pune
6.1	Sangli
6.1	Solapur
6.1	Beed
6.1	Osmanabad
6.2	Gulbarga*
6.2	Aurangabad
6.2	Parbhani
6.2	Nanded
6.2	Jalna
6.2	Latur
6.3	Jalgaon
6.4	Satara
7.2	Medak**
7.2	Mahaboobnagar**
7.2	Rangareddy**

*Karnataka, **Andhra Pradesh, rest in Maharashtra.



Map 3. Districts suitable for up-scaling sweet sorghum cultivation in the selected AEZs.