Africa RISING Ethiopia Highlands project: Selection of project implementation sites

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The Africa Research In Sustainable Intensification for the Next Generation (Africa RISING) program comprises three research-for-development projects supported by the United States Agency for International Development as part of the U.S. government's Feed the Future initiative.

Through action research and development partnerships, Africa RISING will create opportunities for smallholder farm households to move out of hunger and poverty through sustainably intensified farming systems that improve food, nutrition, and income security, particularly for women and children, and conserve or enhance the natural resource base.

The three regional projects are led by the International Institute of Tropical Agriculture (in West Africa and East and Southern Africa) and the International Livestock Research Institute (in the Ethiopian Highlands). The International Food Policy Research Institute leads the program's monitoring, evaluation and impact assessment. http://africa-rising.net/

Introduction

The Africa RISING project of the Feed the Future Initiative proposes to initiate and test interventions to enable sustainable intensification of agriculture in three major regions of Africa by working in "mega-sites" which exemplify the main climatic and human characteristics of these regions. The Highland wheat-producing are of Ethiopia has been selected as representative of extensive densely populated highland areas of east Africa, and results of the initial project will be capable of extrapolation to wide areas of East Africa, as shown in Figures 1 and 2.

This report analyses and stratifies the Ethiopian Highland mega-site, and present recommendations for selection of operational sites within the mega-site.

Figure 1. Extrapolation zones for the three African Mega-Sites
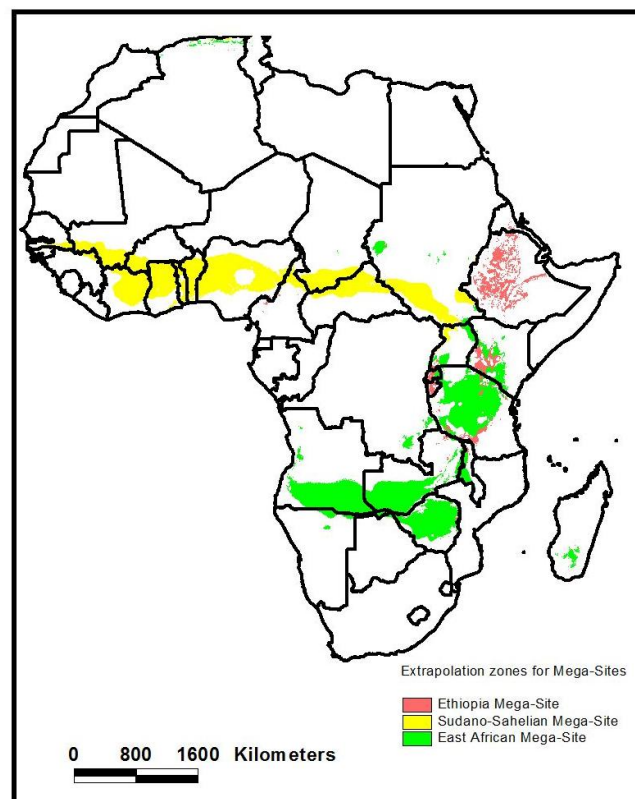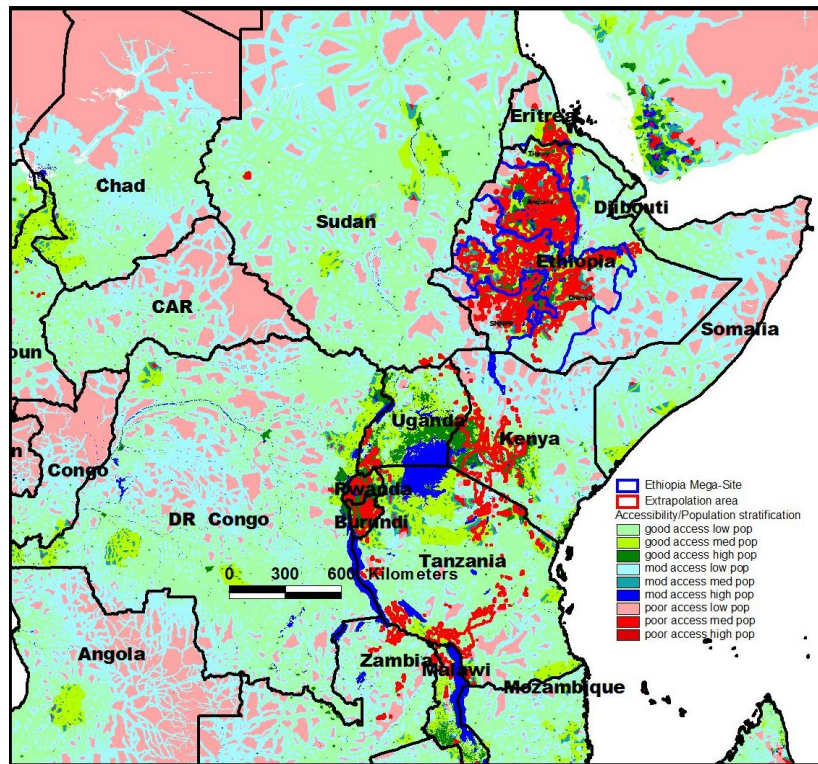
Figure 2. Extrapolation zones for the Ethiopian Highlands Mega Site in East Africa

Background to the Mega-Site

According to Version 3 of the Concept Note for the Ethiopian Highlands Mega-Site (which may be superseded by a modified concept note) "The integrated research will focus on the wheat-growing area in the Ethiopian Highlands. This area exhibits large variations in existing levels of intensification, cereal-legume rotations and other crop-combinations, as well as crop-livestock integration. Furthermore, the factors driving intensification such as agricultural potential, access to available technologies, demand for livestock products, and integration with markets vary a lot within the area.

A number of study sites will be chosen from these wheat-growing areas. They will represent contrasting levels of intensification to enable the characterization of different trajectories and identification of technology combinations that lead to sustainable development pathways. The delineation of the study sites will be done on the basis of political/administrative boundaries (several woredas). The size will be large enough to encompass a range of bio-physically defined areas with contrasting farming systems and a range of social institutions. A more in-depth characterization of the study sites and the entire target zone will form part of further targeting and out-scaling during the project life. This will include a variety of data at different scales and a richer interpretation of household level socio-economic data."
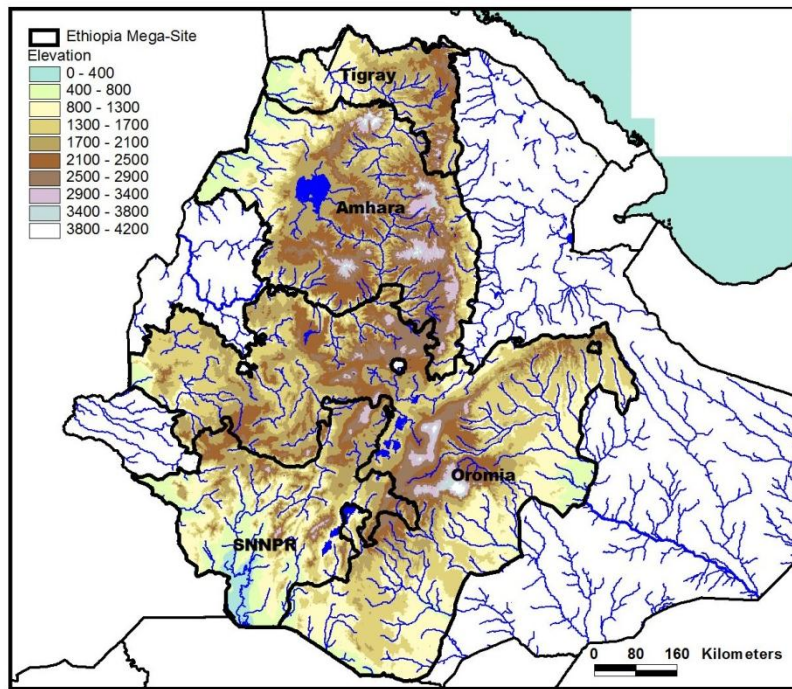
Figure 3. Topography of Ethiopian Highlands
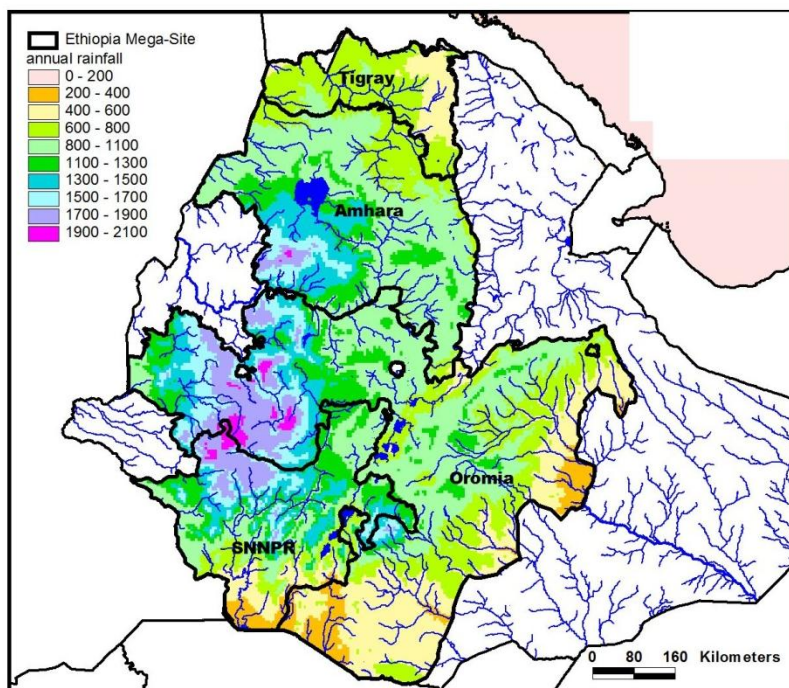
Figure 4. Rainfall in Ethiopian Highlands
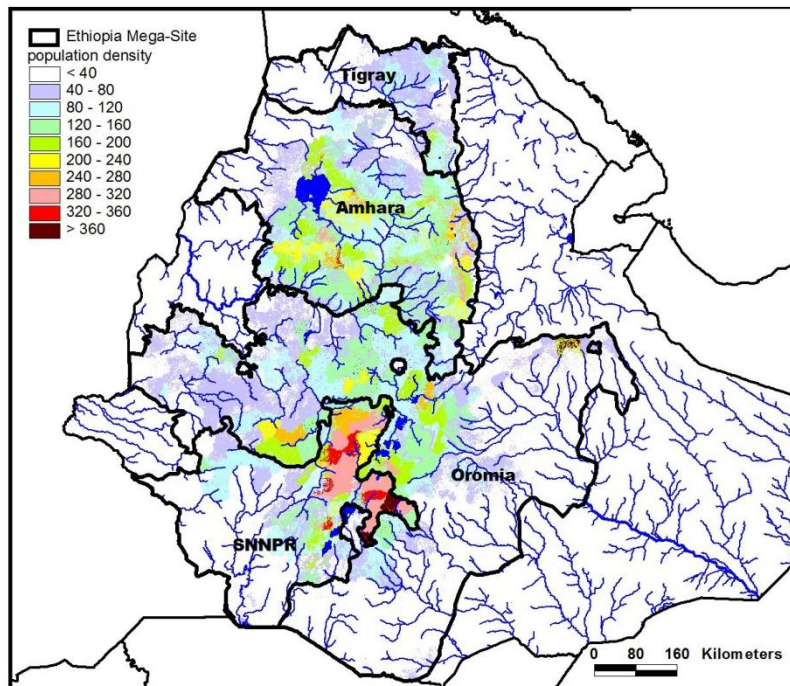
Figure 5. Population distribution in Ethiopian Highlands
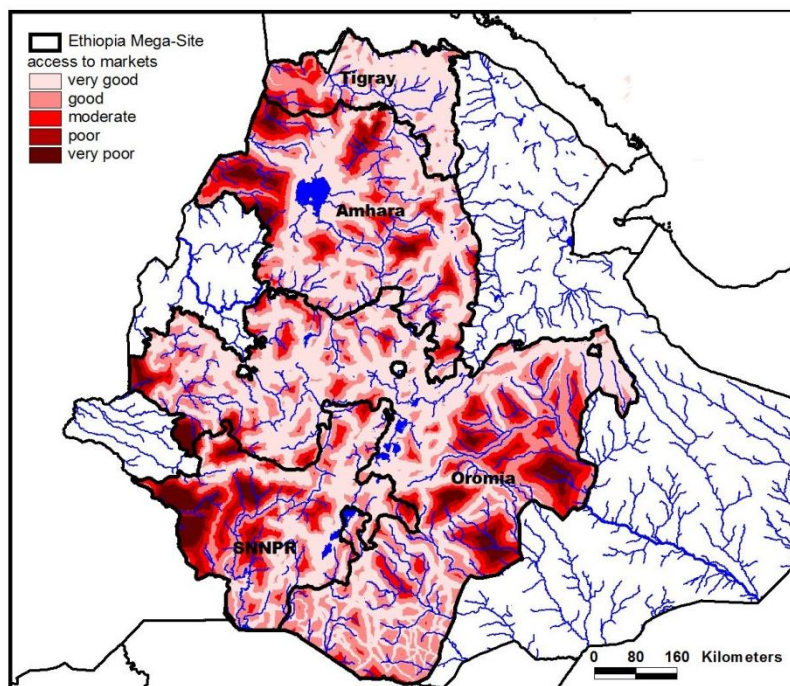
Figure 6. Access to markets in Ethiopian Highlands

Description of Mega-Site

As shown in Figures 3 to 6, the Ethiopian Highlands are extremely diverse topographically, climatically and in respect of population distribution and accessibility of markets. In general, wheat is produced in areas with more than 600mm annual rainfall and at elevations of greater than 1700 metres. There is a crude vertical zonation of cereal crops, from maize at lowest elevations, through teff at medium elevations, then successively wheat and barley at highest elevations.

The variation in elevation and rainfall within single woredas can be extreme. Many woredas are quite large, often more than 1500 square kilometres, and elevation ranges of more than 1500 metres in a single woreda

are not uncommon. Orographic and "rain shadow" effects certainly result in great variation in annual rainfall within single woredas, although this is not captured in sufficient detail in available rainfall maps.

Stratification of the Mega-Site
The first phase of stratification is to identify those woredas where wheat constitutes a significant proportion of the total cereal crop area. A figure of 25% of the total cereal crop area was taken as the cut-off for this targeting study. Out of a total of 656 woredas in the 2008 agricultural atlas, 113 had significant wheat production. USAID and the Ethiopian Government agree that priority should be given in Africa RISING to AGP (Agricultural Growth Plan) woredas. Out of a total of 84 AGP woredas, 19 coincided with wheat-growing woredas. After some discussion, it has been agreed that, while AGP woredas should be targeted preferentially, other non-AGP woredas could be included to fill significant gaps in targeting. The locations of woredas with significant wheat and of AGP woredas are shown in Figures 8 and 9.
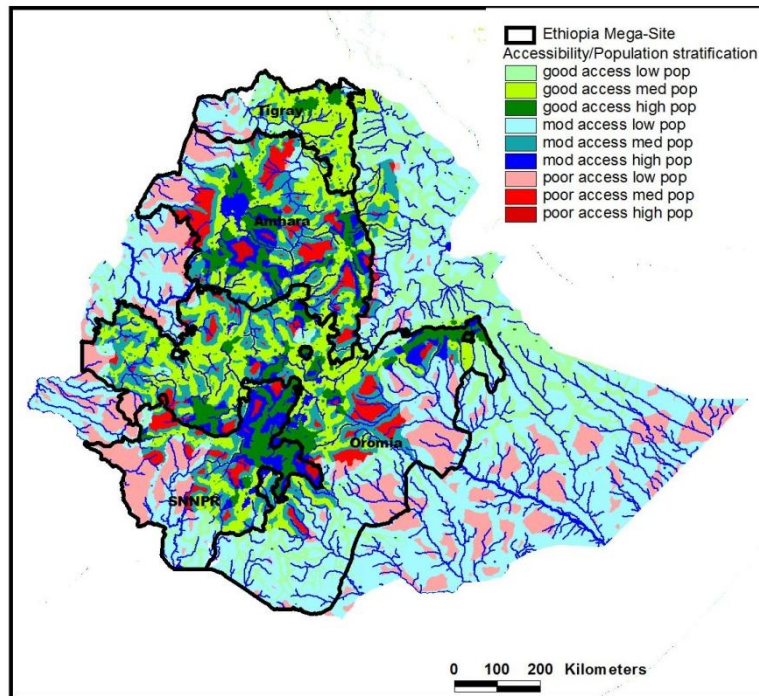
Figure 7. Combination of population density and market access
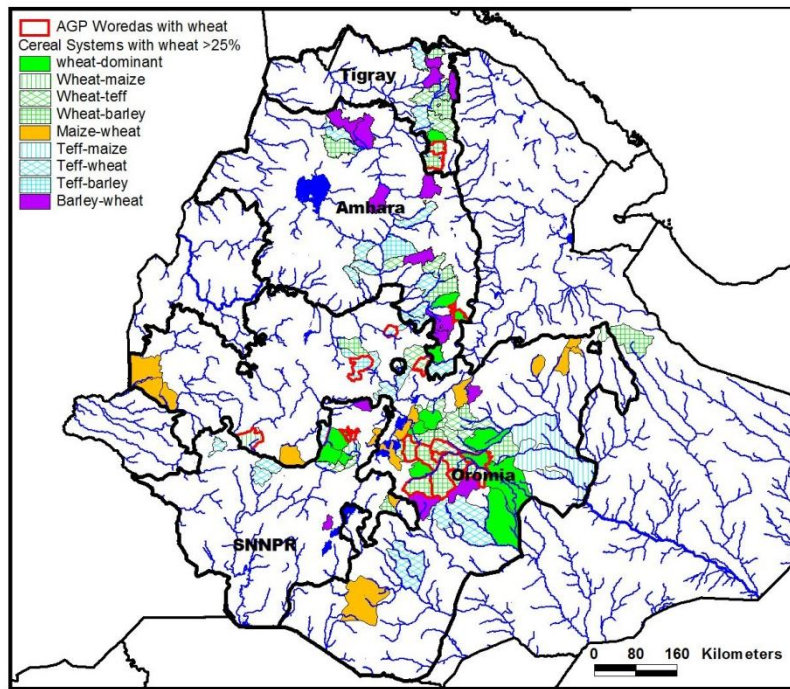
Figure 8. Cereal cropping systems, Woredas with significant wheat, Ethiopian Highlands
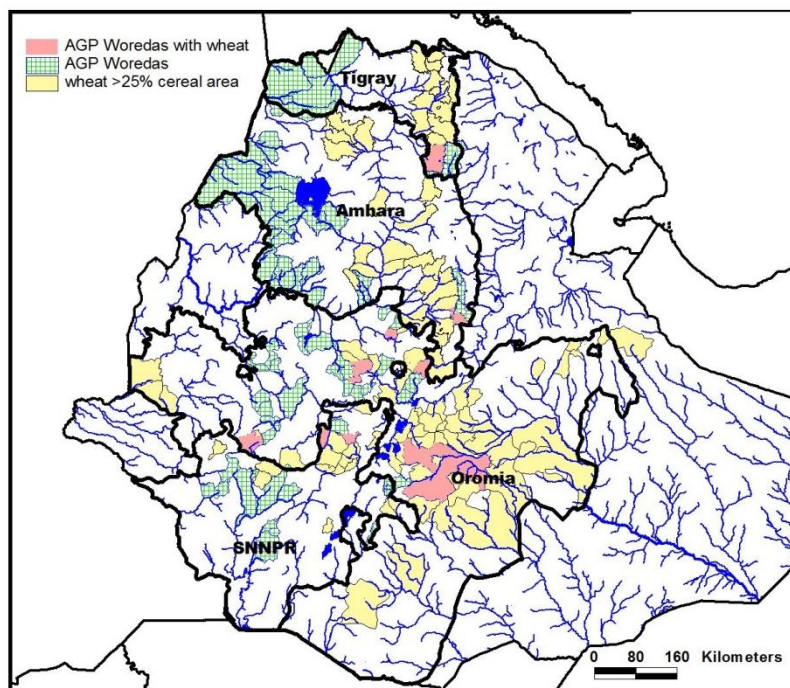
Figure 9. Distribution of AGP Woredas, Ethiopian Highlands

Table 1. Class limits for stratification

Class	Elevation	Rainfall	Slope	Population	TLU/percap	Access
1	<1800 m	< 900 mm	<3 deg	< 100 /km2	< 0.5 percap	Very good
2	1800-2400m	900-1100	3-5 deg	100 - 200	0.5 – 1.0	good
3	> 2400 m	> 1100 mm	> 5 deg	> 200 /km2	> 1.0 percap	moderate
4						poor

Following the initial selection of wheat-producing woredas, further stratification is undertaken on the basis of elevation, rainfall and population density. It is apparent that the large size and extreme topography of many woredas make the use of mean elevation and rainfall problematic, but there is little alternative for this "first-pass" stratification. The mean elevation and rainfall of a woreda may not accurately represent the main cropped areas in the woreda. In some cases the main cultivated areas may be on a plateau at the upper elevation limit of a woreda, while in other most cultivation may occur in lower valleys. Once the initial selection of target woredas is agreed, a further stratification will be undertaken at Keballe level, where the variation within each Keballe will be less than in the larger Woredas.

Stratification on the basis of elevation, rainfall and population density results in 14 distinct classes, as shown in Table 2. Nine of these classes include significant (more than 4) numbers of woredas, so these should all be targeted in order to include the full spectrum of variability in the mega-site.

Implications for Site Selection.

Within each of the nine significant elevation-rainfall-population classes, target woredas have been selected as shown in Table 2 and figure 10. Three further criteria were used to select targets. Market access had to be good to moderate, and livestock density had to be moderate to high. Where there was choice between different cereal cropping systems, those with the most significant wheat production were chosen. Where an AGP woreda existed in a class and met these additional criteria, it was automatically selected. In a few cases, AGP woredas within classes did not meet all of the additional criteria, so these are marked as possible targets depending on how strictly the AGP woreda rule is interpreted. Some elevation-rainfall-population classes are not represented by AGP woredas. This is especially true of the lower elevation classes. In these cases new non-AGP woredas need to be targeted to ensure coverage of the full spectrum of possible variation.

The target woredas suggested represent the best possible combination of all factors considered in the selection, but these are not the only possible targets to ensure coverage of the spectrum of variation. Alternative woredas can be selected based on the data presented in Table 2 if these better satisfy other criteria such as presence of research centres, existing partnerships and other socio-economic factors. The majority of the suggested target woredas are in Oromia region, but two are in Tigray and two in SNNPR. If necessary for political reasons, and alternative site could be selected in Amhara.

Table 2. Classification of Wheat Producing Woredas and Target Identification

Woreda	Zone	Cereals	AG	elevatie	l_ran	mean	rainfal	popdens		ACTLU_F	elev_clas	rain_class	slope_cl	pop_clas	tlu_class	category	Targets
Minjarna Shenkora	North Shewa (K3)	Teff-wheat	0	1567	1498	3.21	781	87	2	0.71	1	1	2	1	2	A	
Merti	Arsi	Maize-wheat	0	1743	2132	2.95	853	98	2	1.04	1	1	1	1	3	A	
Ziway Gugda	Arsi	Maize-wheat	0	1787	669	2.48	786	90	2	1.03	1	1	1	1	3	A	
Legehida	Bale	Teff-maize	0	1243	1124	2.52	666	10	3	0.90	1	1	1	1	2	A	
Seweyna	Bale	Teff-maize	0	975	1698	1.12	538	6	5	0.80	1	1	1	1	2	A	
Arsi Negele	East Shewa	Maize-wheat	0	1795	1493	1.45	783	139	1	0.86	1	1	1	2	2	A	
Goro	Bale	wheat	0	1516	1710	2.77	837	33	2	0.87	1	1	1	1	2	A	potential
Guradamole	Bale	wheat	0	1116	1994	3.10	652	5	4	1.21	1	1	1	1	3	A	
Mennana Arena Buluk	Bale	Teff-wheat	0	1370	3183	2.84	793	16	1	1.07	1	1	1	1	3	A	
Odo Shakiso	Borena	Teff-wheat	0	1530	1376	3.45	743	30	3	1.03	1	1	2	1	3	A	
Yabelo	Borena	Maize-wheat	0	1528	1042	1.91	552	14	2	1.40	1	1	1	1	3	A	
Ginir	Bale	wheat	0	1720	1410	2.16	974	53	3	0.97	1	2	1	1	2	B	potential
Amigna	Arsi	Wheat-teff	0	1713	1608	3.82	958	51	4	1.30	1	2	2	1	3	B	
Seru	Arsi	wheat	0	1648	1625	5.69	965	46	4	1.29	1	2	3	1	3	B	
Gololcha	Bale	Wheat-barley	0	1648	1672	3.78	965	75	3	0.62	1	2	2	1	2	B	
Gidami	West Wellega	Maize-wheat	0	1053	1843	3.81	1087	35	5	0.32	1	2	2	1	1	B	
Ahferom	Central Tigray	Teff-wheat	0	1925	1343	3.66	640	125	2	0.56	2	1	2	2	2	C	
Gulomahda	Easetern Tigray	Wheat-barley	0	2309	1053	4.97	574	161	1	0.46	2	1	2	2	1	C	
Hawzen	Easetern Tigray	Barley-wheat	0	2055	1122	2.88	625	135	1	0.56	2	1	1	2	2	C	
Wukro	Easetern Tigray	Wheat-barley	0	2135	828	3.22	607	114	1	0.51	2	1	2	2	2	C	
Degua Temben	Central Tigray	Wheat-teff	0	2154	1336	6.07	649	109	1	0.61	2	1	3	2	2	C	
Enderta	Southern Tigray	Wheat-barley	0	2149	1050	3.40	576	97	1	0.56	2	1	2	1	2	C	
Samre	Southern Tigray	Teff-wheat	0	1817	1258	4.21	639	71	2	0.91	2	1	2	1	2	C	
Hintalo Wajirat	Southern Tigray	Wheat-teff	0	2146	2018	5.30	575	83	2	0.68	2	1	3	1	2	C	
Ofla	Southern Tigray	Wheat-barley	1	2383	1964	7.30	772	147	2	0.54	2	1	3	2	2	C	AGP target
Jijiga	Jijiga	Wheat-barley	0	1803	1027	2.00	745	107	2	0.46	2	1	2	1	2	C	
Dodotana Sire	Arsi	Wheat-teff	0	1880	1541	2.45	865	134	1	0.73	2	1	1	2	2	C	
Dodotana Sire	Arsi	Wheat-teff	0	1880	1541	2.45	865	134	1	0.73	2	1	1	2	2	C	
Jarso	East Harerghe	Wheat-maize	0	2006	1603	5.58	803	215	2	0.47	2	1	3	3	1	D	
Kurfa Chele	East Harerghe	Maize-wheat	0	2043	1739	5.54	853	219	1	0.37	2	1	3	3	1	D	
Bedeno	East Harerghe	Maize-wheat	0	1841	1998	7.08	864	236	2	0.51	2	1	3	3	2	D	
Lanfero	Guraghe	Maize-wheat	0	1836	711	1.42	888	220	2	0.84	2	1	1	3	2	D	
Hagere Mariamna Kesem	North Shewa (K3)	wheat	0	2367	2016	6.50	909	77	3	0.85	2	2	3	1	2	E	
Agarfa	Bale	Wheat-barley	1	2356	2391	5.24	1035	73	3	1.23	2	2	3	1	3	E	
Nenesebo	Bale	Barley-wheat	0	2330	1940	6.02	1061	37	3	1.49	2	2	3	1	3	E	
Debark	North Gonder	Barley-wheat	0	2054	2973	6.99	919	102	3	0.55	2	2	3	2	2	F	
Dabat	North Gonder	Teff-wheat	0	1918	1830	5.88	940	128	2	0.63	2	2	3	2	2	F	
Wegera	North Gonder	Wheat-barley	0	2167	1888	4.91	1004	125	3	0.58	2	2	2	2	2	F	
Sayint	South Wollo	Teff-barley	0	2303	2921	8.50	1085	112	4	0.78	2	2	3	2	2	F	
Debresina	South Wollo	Wheat-teff	0	2194	2316	7.76	1055	173	3	0.83	2	2	3	2	2	F	
Jama	South Wollo	Teff-wheat	0	2362	1232	6.25	1029	123	1	0.72	2	2	3	2	2	F	
Moretna Jiru	North Shewa (K3)	Teff-wheat	0	2092	1373	8.50	922	144	2	0.45	2	2	3	2	1	F	
Siya Debirna Wayu & Ensaro	North Shewa (K3)	Teff-wheat	0	2340	1425	4.47	925	141	2	0.50	2	2	2	2	2	F	
Yaya Gulelena Debre Libanos	North Shewa (K4)	Teff-wheat	1	2353	1361	4.96	1007	175	3	0.71	2	2	2	2	2	F	
Jeldu	West Shewa	Wheat-barley	0	2251	1802	6.06	1087	150	2	0.97	2	2	3	2	2	F	
Gimbichu	East Shewa	Wheat-teff	1	2283	1008	3.22	939	108	2	0.77	2	2	2	2	2	F	
Akaki	East Shewa	Teff-wheat	0	2073	1102	2.13	969	103	1	0.83	2	2	1	2	2	F	
Kersana Kondaltiti	West Shewa	Teff-wheat	0	2307	1736	2.67	1070	114	2	0.81	2	2	1	2	2	F	
Aseko	Arsi	Barley-wheat	0	2279	1778	8.46	1074	128	3	0.92	2	2	3	2	2	F	
Chole	Arsi	Wheat-barley	0	2385	2295	7.90	1070	142	3	0.81	2	2	3	2	2	F	
Sude	Arsi	Wheat-teff	0	2330	1527	5.84	1093	114	3	0.96	2	2	3	2	2	F	
Robe	Arsi	Wheat-teff	0	2132	2700	5.20	1099	121	3	1.02	2	2	3	2	3	F	
Shirka	Arsi	Wheat-teff	1	2233	2370	5.27	1039	142	2	1.09	2	2	3	2	3	F	
Gasera	Bale	wheat	1	2140	1312	4.71	1099	138	3	0.54	2	2	2	2	2	F	AGP target
Mojana Wadera	North Shewa (K3)	wheat	1	1991	2240	6.93	1040	150	2	0.34	2	2	3	2	1	F	
Kersa	East Harerghe	Maize-wheat	0	2117	1360	4.35	903	357	1	0.44	2	2	2	3	1	G	
WEREDA 19	Zone 3	Teff-wheat	0	2224	275	2.08	1041	3439	1	0.05	2	2	1	3	1	G	
WEREDA 26	Zone 6	Teff-wheat	0	2173	214	1.12	1007	586	1	0.21	2	2	1	3	1	G	
WEREDA 27	Zone 6	Teff-wheat	0	2116	113	1.20	986	1808	1	0.11	2	2	1	3	1	G	
Limu	Hadiya	Wheat-maize	1	2166	1200	2.59	1029	411	2	0.59	2	2	1	3	2	G	AGP target
Menjiwo	Kaffa	Teff-wheat	0	2145	2116	7.22	1750	96	3	0.81	2	3	3	1	2	H	
Gera	Jimma	Wheat-maize	1	2124	1588	3.95	1876	68	3	0.99	2	3	2	1	2	H	
Gesha Daka	Kaffa	Teff-wheat	0	2221	808	2.12	1929	45	4	0.50	2	3	1	1	2	H	
Goncha Siso Enese	East Gojam	Teff-wheat	0	2252	2002	6.15	1234	141	2	0.59	2	3	3	2	2	J	
Enarj Enawga	East Gojam	Teff-wheat	0	2316	2800	6.44	1193	173	2	0.62	2	3	3	2	2	J	
Kedida Gamela	Kembata Alaba Temb	Wheat-teff	0	2048	920	3.64	1107	614	2	0.42	2	3	2	3	1	J	
Kacha Bira	Kembata Alaba Temb	Wheat-teff	0	1993	1268	3.56	1252	544	1	0.47	2	3	2	3	1	J	
Yem	Yem Special Woreda	Teff-wheat	1	1902	1798	7.85	1246	115	2	0.67	2	3	3	2	2	J	AGP poss
Misha	Hadiya	wheat	0	2007	1876	3.18	1107	321	3	0.54	2	3	2	3	2	J	potential
Soro	Hadiya	wheat	0	1858	1954	4.08	1227	300	3	0.54	2	3	2	3	2	J	potential
Dedo	Jimma	Maize-wheat	0	1875	1983	5.62	1565	186	3	0.83	2	3	3	2	2	J	
Angacha	Kembata Alaba Temb	wheat	0	2265	967	2.99	1163	553	2	0.46	2	3	1	3	1	J	
Ganta Afeshum	Easetern Tigray	Barley-wheat	0	2457	1221	5.73	583	319	1	0.35	3	1	3	3	1	K	

| Woreda	Zone	Cereals	AG	elevation	l_range	slope	mean rainfall	popdens	AC	TLU_F	elev_clas	rain_class	slope_cla	pop_clas	tlu_class	category	Targets
Ganta Afeshum	Easetern Tigray	Barley-wheat	0	2457	1221	5.73	583	319	1	0.35	3	1	3	3	1	K	
Atsbi Wenberta	Easetern Tigray	Barley-wheat	0	2478	1606	5.35	597	120	1	0.73	3	1	3	2	2	K	
Ambalaje	Southern Tigray	wheat	0	2468	2112	8.44	657	142	2	0.54	3	1	3	2	2	K	
Endamehoni	Southern Tigray	Wheat-barley	1	2607	1932	8.66	742	174	2	0.44	3	1	3	2	1	K	AGP targe
Gidan	North Wollo	Barley-wheat	0	2864	2126	8.11	899	143	2	0.65	3	1	3	2	2	K	
Janamora	North Gonder	Barley-wheat	0	2572	2898	8.34	918	90	4	0.59	3	2	3	1	2	L	
Adaba	Bale	Wheat-barley	1	2929	2327	5.20	1016	59	4	1.06	3	2	3	1	3	L	
Endagagn	Guraghe	wheat	1	2527	676	2.74	1013	0	2		3	2	1	1	0	L	AGP targe
Goba	Bale	Barley-wheat	0	2938	2827	6.19	1059	52	4	0.73	3	2	3	1	2	L	
Dawunt Delanta	North Wollo	Teff-wheat	0	2538	2353	8.08	1000	120	3	0.77	3	2	3	2	2	M	
Gera Midirna Keya Gabriel	North Shewa (K3)	Wheat-barley	0	2692	2018	7.52	1076	104	4	0.76	3	2	3	2	2	M	
Mama Midirna Lalo	North Shewa (K3)	wheat	0	2666	1723	7.31	1049	132	2	0.72	3	2	3	2	2	M	
Debre Berhan Zuria	North Shewa (K3)	Barley-wheat	0	2654	1938	5.86	977	114	2	0.84	3	2	3	2	2	M	
Berehna Aleltu	North Shewa (K4)	Wheat-teff	0	2631	1435	2.71	1026	120	2	1.08	3	2	1	2	3	M	
Gedeb	Arsi	wheat	1	2604	1572	1.68	915	153	2	1.21	3	2	1	2	3	M	
Sinanana Dinsho	Bale	Wheat-barley	1	2743	2547	2.88	1050	104	2	0.88	3	2	1	2	2	M	AGP targe
Hitosa	Arsi	wheat	0	2644	2308	3.70	1050	191	2	0.71	3	2	2	2	2	M	
Angolela Tera	North Shewa (K3)	Barley-wheat	0	2763	1484	3.26	958	104	2	0.81	3	2	2	2	2	M	
Tiyo	Arsi	wheat	0	2541	2086	4.29	1035	268	2	0.46	3	2	2	3	1	M	
Munessa	Arsi	Wheat-barley	1	2429	2253	3.04	1001	129	3	1.15	3	2	2	2	3	M	
Bekoji	Arsi	Wheat-barley	1	2793	2547	3.43	1036	150	2	1.18	3	2	2	2	3	M	
Dodola	Bale	Wheat-barley	1	2776	1352	3.36	988	108	2	1.17	3	2	2	2	3	M	
Lay Gayint	South Gonder	Barley-wheat	0	2411	2564	6.90	1100	151	3	0.52	3	3	3	2	2	N	
Legambo	South Wollo	Barley-wheat	0	3060	1877	6.25	1192	182	2	0.62	3	3	3	2	2	N	
Were Ilu	South Wollo	Wheat-teff	0	2661	1822	5.65	1118	151	2	0.79	3	3	3	2	2	N	
Gishe Rabel	North Shewa (K3)	Wheat-barley	0	2682	1522	7.56	1118	95	4	0.76	3	3	3	1	2	N	
Debay Telatgen	East Gojam	Teff-wheat	0	2848	1581	4.44	1375	193	2	0.68	3	3	2	2	2	N	
Dendi	West Shewa	Teff-barley	1	2445	1661	3.89	1143	149	3	0.86	3	3	2	2	2	N	AGP poss
Ejere (Addis Alem)	West Shewa	Teff-wheat	0	2409	879	2.11	1116	160	2	0.74	3	3	1	2	2	N	
WEREDA 28	Zone 3	Teff-wheat	0	2473	793	2.87	1100	724	1	0.21	3	3	1	3	1	N	
Kokir Gedbano Gutazer	Guraghe	Barley-wheat	0	2658	1562	4.30	1181	152	4	0.93	3	3	2	2	2	N	
Tena	Arsi	Wheat-barley	0	2724	2294	4.69	1103	176	2	0.90	3	3	2	2	2	N	potential
Degeluna Tijo	Arsi	Wheat-barley	0	2835	1641	2.63	1125	142	2	0.89	3	3	1	2	2	N	potential
Arbe Gona	Sidama	Maize-wheat	0	2553	1339	2.64	1311	410	3	0.88	3	3	1	3	2	N	
Hulla	Sidama	Wheat-barley	0	2494	1487	3.52	1430	387	2	0.90	3	3	2	3	2	N	potential
Chencha	Gamo Gofa	Barley-wheat	0	2491	1872	7.43	1349	323	1	0.53	3	3	3	3	2	N	
Omo Sheleko	Kembata Alaba Temb	Teff-wheat	0	1614	1795	6.26	1266	391	2	0.47	1	3	3	3	1		
Telo	Kaffa	Teff-wheat	0	1995	2347	8.10	0	81	3	0.54	2		3	1	2		
Mesela	West Harerghe	Maize-wheat	0	1753	1596	8.55	944	191	3	0.53	1	2	3	2	2		
Anfilo	West Wellega	Maize-wheat	0	1138	1976	4.48	1177	45	4	0.21	1	3	2	1	1		
Sayo	West Wellega	Maize-wheat	0	1340	1739	4.53	1308	125	2	0.35	1	3	2	2	1		
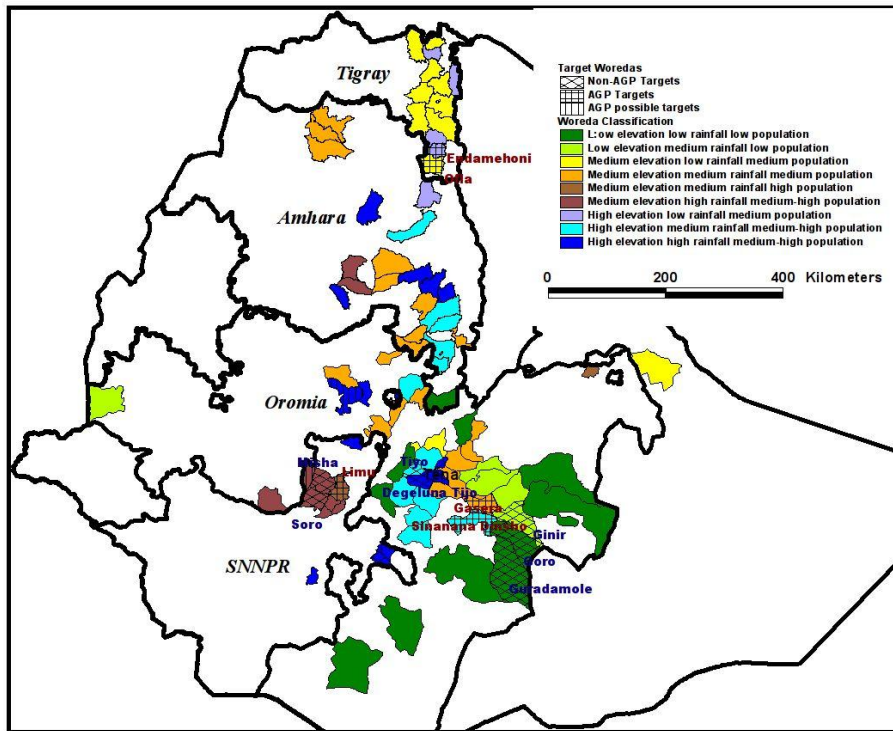
Figure 10. Classification of Woredas and recommended targets