

9.5 Productivity Analysis and Hydrogeological Map

9.5.1 Productivity Analysis

Productivity distribution of groundwater was presumed by the geological condition, yield of existing wells, rainfall, topographic feature and the result of satellite image analysis

(1) Yield of existing wells

The yield value in the borehole catalogue was referred by its distribution map. In this regard, analysis method of pumping test was doubtful mentioning in the borehole catalogue. For example, although the yield value was very high, if the drawdown was much deeper than water struck, it could be considered that the test was conducted to exceed the possibility of aquifer.

The yield distribution map is shown in **Figure 9-9**. Although the data distribution is uneven and the data are including some error, the distribution map can show the feature of productivity in whole IDB area relatively.

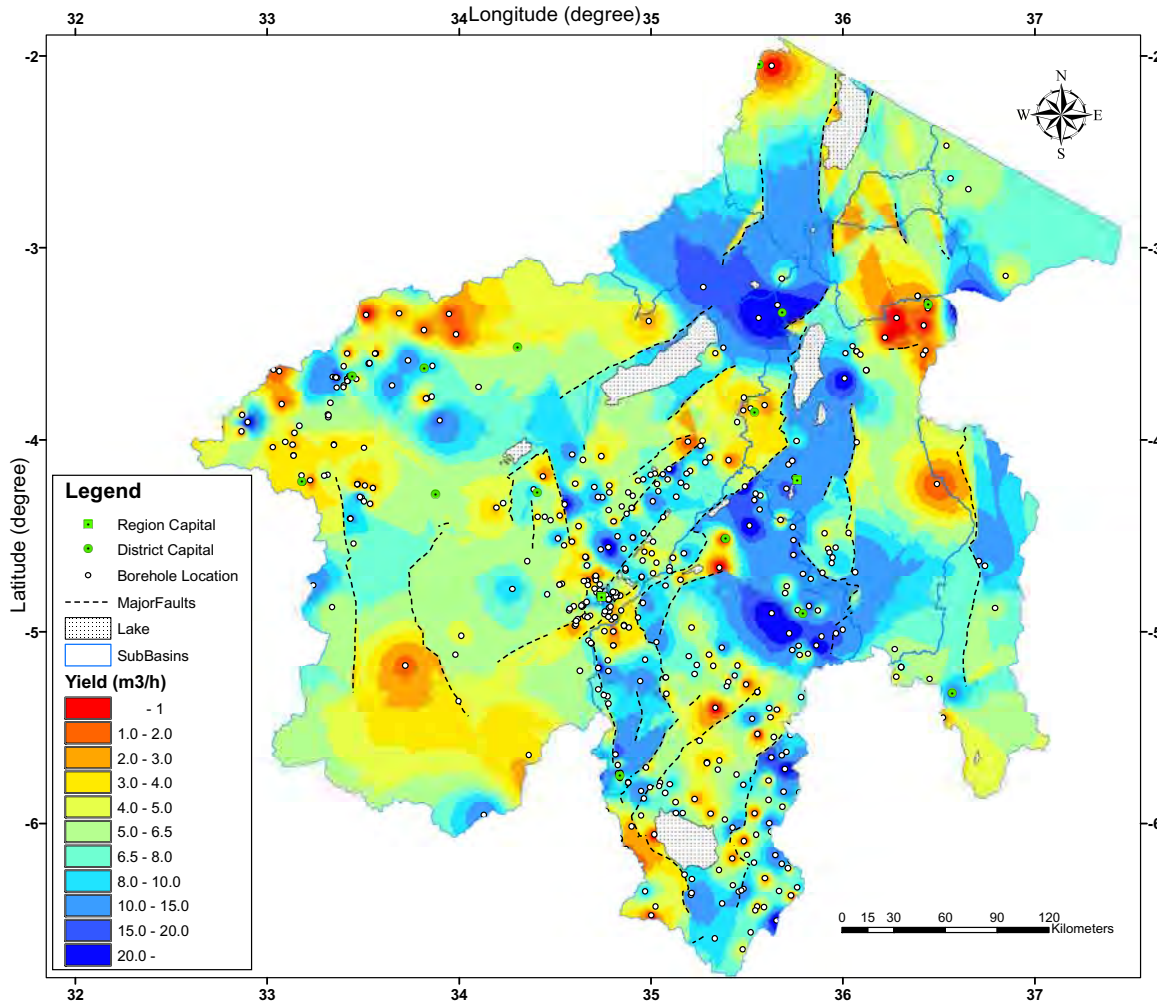


Figure 9-9 Well Yield Distribution of Existing Wells

(2) Rainfall

Average annual rainfall for 30 years up to 1970th was referred. Details in Chapter 2.

(3) Topography

Recharge areas or direction of flow are read from topography. Top of mountain and steep slope area are considered to be impossible to develop groundwater. These areas are eliminated as masked area.

(4) Satellite Image Analysis

Mainly VSW index map was referred for this analysis. Comparison between the VSW index map and the existing geological map can be used for the interpretation of Productivity analysis.

In the VSW map, Blue shows water (moisture), Green shows vegetation, Red shows soil, basically. Other colors should be interpreted. Especially, in this area, lakes and swamps show the different colors.

Table 9-8 Interpretation of VSW Map

Color	Phenomenon	Representative place
Blue	Water	Lake Babati, Lake Singida, some other small lakes
Dark green	Wet forest	Several part (not large area)
Light green	Forest, congestion of trees	Uyui, Sikonge, Manyoni
Orange	Sand area	Around Singida
Red	Bare land	Sediment in Massai Steppe
	Volcanic ash	Northern part of IDB
Purple-red	Saline lake, swamp	Lake Natron, Lake Eyasi, Lake Manyara, Bahi swamp, part of Bubu river
Purple	Mbuga clay	Several places at locally low area
	Basaltic rocks	Around volcanoes

Groundwater productivity was estimated from geological condition and above data. Productivity distribution map is shown in **Figure 9-10**. The feature of productivity distribution is assembled in **Table 9-9**.

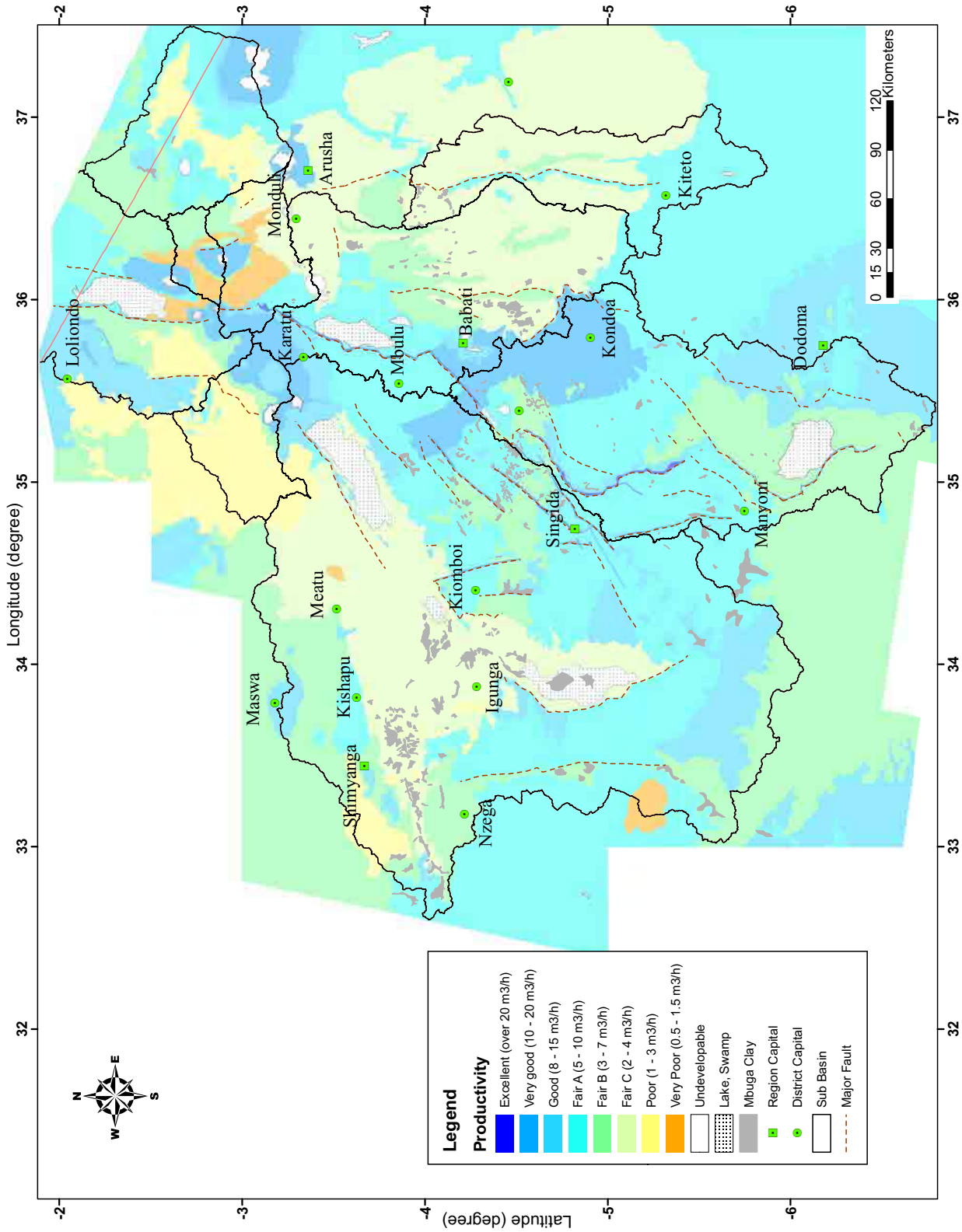


Figure 9-10 Groundwater Productivity Classification for Hydrogeological Map

Table 9-9 Groundwater Productivity Condition in IDB

	Estimated Productivity (m ³ /h)	Place	Description
Excellent	over 20	Along large scale fault	Fracture zone related to the Great Rift Valley System
Very Good	10 - 20	The belt area from west of Mbulu district through east of Hanang district and west of Babati district to Kondoa district	Boundary area between granitic rock area and Usagaran metamorphic rock area.
		Foot of volcanoes	Much amount of recharge is expected from the mountains
		The south of Loliondo	Much rainfall in Usagaran metamorphic rock area
Good	8 - 15	The west of Shinyanga town, around Maswa town, north of Tinde village, south of Igunga district, west of Singida rural district, northwest of Dodoma town, around Loliondo town. Uyui and Sikonge district	The place which has many fault or lineament and inselberg in granitic rock area
		Karatu district	Much amount of recharge is expected from Ngorongoro mountain
		Around Loliondo	Much rainfall in Usagaran metamorphic rock area
Fair A	5 - 10	Kishapu district, Igunga district, the north of Igunga district	Most of granitic rock area
		Around Kiteto town, Mbulu district	Hilly area of Usagaran metamorphic rock
		Around Lake Manyara,	Lake Manyara sediment has groundwater recharge from surrounding mountain.
Fair B	3 - 7	Between Maswa and Kishapu districts	Plateau of granitic area has low recharge of groundwater
		Bahi lowland area	Clayey sand
		southern part of Monduli district and the northeast of Babati district	Usagaran metamorphic rock (Xs-a)
Fair C	2 - 4	Eastern part of Meatu district	Fresh granitic rock is distributed
		Lowland surrounding Manonga river, Lake kitangiri, Lake Eyasi, and Wembere swamp	Clayey sediment
		Masai Steppe	Less rainfall
Poor	1 - 3	Shinyanga Rural district	Less recharge of groundwater
		Oldubai to Lake Natron	Less recharge of groundwater
		West of Longido	Volcanic ash
Very Poor	0.5 - 1.5	West of Uyui district, east of Meatu town	Less fracture of granitic rock
		Lowland surrounding Kitumbeine mountain	High evaporation

9.5.2 Hydrogeological Mapping

Adding the geological distribution, water quality and water level to the productivity distribution, Hydrogeological Map was completed. The hydrogeological map is shown in **Figure 9-11**.

Mbuga clay areas which become marsh in rainy season are shown in the map by grey in colour. It is difficult to construct a water supply facility in this area.

Steep slope areas, which are cliff of fault and top of mountain area, are shown as impossible area for development of groundwater.

Groundwater potential by district is roughly evaluated based on the hydrogeological map. Score of the evaluation is divided into three. The criteria are shown in **Table 9-10**. The result is shown in **Table 9-11**. According to this result, Karatu district and Babati district have high potential for groundwater development.

Detailed potential evaluation is discussed in chapter 5.

Table 9-10 Criteria of the Evaluation of Groundwater Potential

Item \ Score	Good (O)	Fair (Δ)	Poor (X)
Drilling depth	Less than 80 m	80 - 150 m	Over 150 m
Static Water Level	Less than 20 m	20 - 40 m	Over 40 m
Productivity	Over 10 m ³ /h	2 - 10 m ³ /h	Less than 2 m ³ /h
Salinity	Less than 100 mS/m	100 - 300 mS/m	over 300 mS/m
Fluoride	Less than 1.5 mg/l	1.5 - 4.0 mg/l	Over 4.0 mg/l

Table 9-11 Outline of Groundwater Development Potential by District

Region	District	Drilling depth	SWL	Productivity	Salinity	Fluoride	Comment
Arusha	Monduli	X	X	X	Δ	Δ	Northern part: relatively good Southern part Poor
	Arumeru	X	X	O	Δ	X	High fluoride contents
	Ngorongoro	Δ	O	Δ	Δ	Δ	Northern highland and Southern part are good Eastern and western lowlands are poor
	Karatu	O	O	O	O	O	
Manyara	Babati	O	O	O	O	O	Highland is good, Magugu area has saline groundwater
	Mbulu	O	Δ	Δ	O	O	
	Hanang	X	X	Δ	Δ	X	Around Mt. Hanang: high fluoride, Basotu lowland has saline water
	Kiteto	X	X	X	X	Δ	Ndedo, Makame lowland has saline groundwater
	Simanjiro	X	Δ	X	X	Δ	
Dodoma	Dodoma	X	Δ	O	Δ	O	Bahi lowland has saline groundwater
	Kondoa	X	Δ	O	O	O	
Singida	Singida	Δ	O	Δ	Δ	X	High productivity area along faults
	Manyoni	Δ	Δ	Δ	O	O	
	Iramba	Δ	O	Δ	Δ	X	Locally high salinity groundwater
Shinyanga	Shinyanga	O	O	Δ	X	X	Locally high Fluoride contents, West sided of Shinyanga town has high productivity
	Maswa	O	O	Δ	X	X	Around Maswa town has high productivity
	Meatu	O	O	Δ	X	X	High fluoride and salinity area
	Kishapu	O	O	Δ	X	X	High fluoride and salinity area
Tabora	Igunga	O	Δ	Δ	Δ	Δ	Locally high fluoride contents, Lowland area has saline groundwater
	Nzega	O	O	Δ	Δ	O	
	Uyui	O	Δ	Δ	O	O	Locally high saline groundwater and high fluoride contents near Wembere swamp
	Sikonge	O	Δ	Δ	O	O	

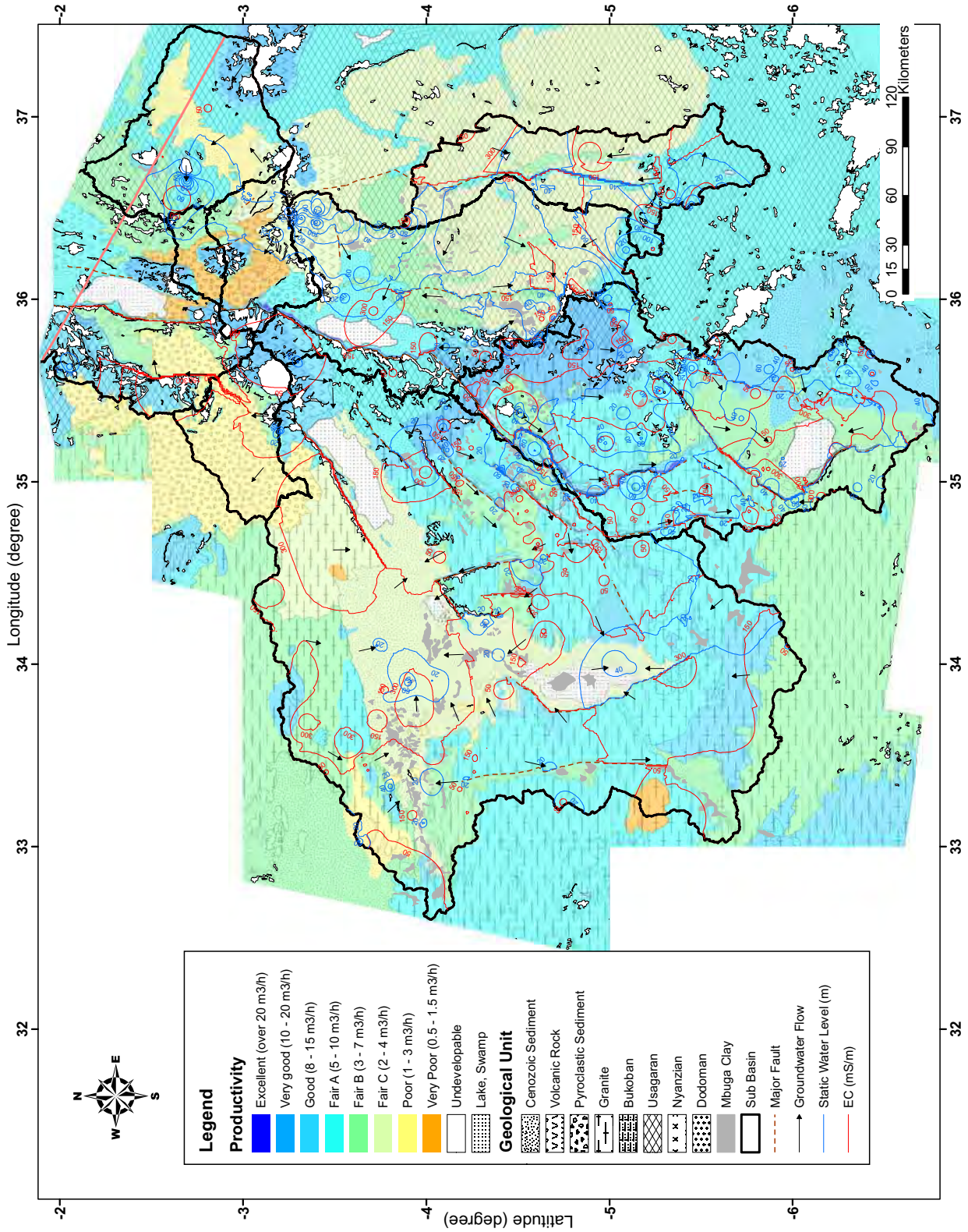


Figure 9-11 Hydrogeological Map of Internal Drainage Basin