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PD<sub>312</sub>, VI<sub>9</sub>, MIRV<sub>1</sub>, GVI  
MIRV<sub>2</sub> VI<sub>5</sub>, Tgr MIRV<sub>1</sub>

MIRV<sub>1</sub> VI<sub>6</sub> VI<sub>10</sub>  
Fuse<sub>2</sub> MIRV<sub>2</sub>, VI<sub>12</sub>, VI<sub>5</sub>

VI<sub>10</sub>

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TSAVI

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TM

TM

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PVI NDVI SAVI

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Jakson et al  
Rondeaux  
Duncan et al

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Maxwell  
Tueller  
Richards

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SAVI

MSAVI TSAVI

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SBI DVI PVI<sub>6</sub>

PVI

PVI GVI

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Vegetation Index	Code	Formula
Ratio Vegetation Index (Near-InfraRed Ratio)	RVI (NIR)	NIR/RED
Ratio Vegetation Index <sub>1</sub>	RVI <sub>1</sub>	Sqrt (NIR/RED)
Moisture Stress Index	MSI	ETM <sub>5</sub> /NIR
Mid InfraRed Index	MIR	ETM <sub>5</sub> /ETM <sub>7</sub>
Green Normalized Difference Vegetation Index <sub>1</sub>	GNDVI <sub>1</sub>	(NIR-ETM <sub>1</sub> )/ (NIR+ETM <sub>1</sub> )
Green Normalized Difference Vegetation Index <sub>2</sub>	GNDVI <sub>2</sub>	(NIR-ETM <sub>2</sub> )/ (NIR+ETM <sub>2</sub> )
Normalized Difference Vegetation Index	NDVI	(NIR- RED)/ (NIR+ RED)
Transformed Vegetation Index	TVI	(NIR- RED)/ (NIR+ RED)+ 0.5
Transformed Vegetation Index <sub>1</sub>	TVI <sub>1</sub>	Sqrt ( ( (NIR- RED)/ (NIR+ RED))+0.5)
Transformed Vegetation Index <sub>2</sub>	TVI <sub>2</sub>	(Sqrt (2)* NIR- Sqrt (2)* RED)
Soil Water Content Index (InfraRed Index)	SWCI (IR)	(NIR- ETM <sub>7</sub> )/ (NIR+ETM <sub>7</sub> )
Modified Normalised Difference Index	MNDI	NIR- (1.2* RED)/ (NIR+ RED)
Leaf Water Content Index (InfraRed Index)	LWCI (IR)	(NIR-ETM <sub>5</sub> )/ (NIR+ ETM <sub>5</sub> )
Normalized Ratio Vegetation Index	NRVI	(RVI-1)/ (RVI+1)
Green Vegetation Index	GVI	0.2848*ETM <sub>1</sub> -0.2435*ETM <sub>2</sub> - 0.5436* RED+0.7243* NIR+0.0840* ETM <sub>5</sub> +0.1800*ETM <sub>7</sub>
InfraRed Percentage Vegetation Index	IPVI	NIR/ (NIR+ RED)
Defrence Vegetation Index	DVI	NIR- RED
Soil Bare Index	SBI	(ETM <sub>1</sub> -ETM <sub>2</sub> )/ (ETM <sub>1</sub> +ETM <sub>2</sub> )
Perpendicular Vegetation Index	PVI	sin a* NIR-cos a* RED
Perpendicular Vegetation Index <sub>1</sub>	PVI <sub>1</sub>	((b* NIR-RED*a)/ b <sup>2</sup> +1) <sup>0.5</sup>  = b =a
Perpendicular Vegetation Index <sub>2</sub>	PVI <sub>2</sub>	a* NIR-b* RED
Soil Adjusted Vegetation index	SAVI	( ( (NIR- RED)/255)/ ( ( (NIR+ RED)/255)+L))* (L+1)
Soil Adjusted Vegetation index <sub>1</sub>	SAVI <sub>1</sub>	(NIR- RED)* (1+L)/ (NIR+ RED+L)
Transformed Soil Adjusted Vegetation index <sub>1</sub>	TSAVI <sub>1</sub>	a* (NIR-a* RED-b)/ (RED+a* NIR-a*b)
Transformed Soil Adjusted Vegetation index <sub>2</sub>	TSAVI <sub>2</sub>	a* (NIR-a* RED-b)/ (RED+a* NIR-a*b+0.8* (1+a <sup>2</sup> ))
Weighted Difference Vegetation Index	WDVI	NIR- (a* RED)
Modified Soil Adjusted Vegetation Index <sub>1</sub>	MSAVI <sub>1</sub>	(NIR- RED)* (1+L)/ (NIR+ RED+L) L=1- (2*a*NDVI*WDVI)
Modified Soil Adjusted Vegetation Index <sub>2</sub>	MSAVI <sub>2</sub>	0.5* (2* NIR+1- ((2* NIR+1) <sup>2</sup> -8* (NIR- RED)) <sup>0.5</sup> )
AETMospherically Vegetation Index	ARVI	(NIR- (RED- (ETM <sub>1</sub> - RED)))/ (NIR+ (RED- (ETM <sub>1</sub> - RED)))

Vegetation Index	Code	Formula
AETMospherically Vegetation Index <sub>1</sub>	ARVI <sub>1</sub>	$(NIR-RB) / (NIR+RB)$ RB= RED- $\gamma$ * (ETM <sub>1</sub> - RED) $\gamma = 1$
Soil Adjusted and Atmospherically Resistant VI	SARVI	$(NIR - (RED - (ETM_1 - RED))) / (NIR - (ETM_1 - RED) + L)$
Global Environmental Monitoring Index	GEMI	$\xi * (1 - 0.25 * \xi) - ((RED - 0.125) / (1 - RED))$ $\xi = (2 * (NIR)^2 - (RED)^2) + (1.5 * NIR + 0.5 * RED) / (NIR + RED + 0.5)$
Enhanced Vegetation Index	EVI	$2.5 * ((NIR - RED) / (NIR + RED - 7.5 * ETM_1 + 1))$
Transformed Normalized Ratio Vegetation Index	TNDVI	$(NDVI + 1) * 100$
Leaf Area Index	LAI	$-1.913 + 4.831 * NDVI$
Leaf Area Index <sub>1</sub>	LAI <sub>1</sub>	$NDVI / (3.26 - 2.9 + NDVI)$
NRR	NRR	$(NIR - RED) / RED$
BI	BI	$ETM_1 + ETM_2 + RED + NIR + ETM_5 + ETM_7 / 6$
BI <sub>1</sub>	BI <sub>1</sub>	$ETM_1 + ETM_2 * 2 + RED + NIR * 2 + ETM_5 + ETM_7 / 6$
BI <sub>2</sub>	BI <sub>2</sub>	$ETM_1 + ETM_2 + RED + NIR + ETM_5 + ETM_7$
MINI	MINI	$(ETM_7 - NIR) / (ETM_7 + NIR)$
MIRV <sub>1</sub>	MIRV <sub>1</sub>	$(ETM_7 - RED) / (ETM_7 + RED)$
MIRV <sub>2</sub>	MIRV <sub>2</sub>	$(ETM_5 - RED) / (ETM_5 + RED)$
PD <sub>311</sub>	PD <sub>311</sub>	$RED - ETM_1$
PD <sub>312</sub>	PD <sub>312</sub>	$(RED - ETM_1) / (RED + ETM_1)$
PD <sub>321</sub>	PD <sub>321</sub>	$RED - ETM_2$
PD <sub>322</sub>	PD <sub>322</sub>	$(RED - ETM_2) / (RED + ETM_2)$
VI <sub>1</sub>	VI <sub>1</sub>	$RED * NIR / ETM_2$
VI <sub>2</sub>	VI <sub>2</sub>	$RED * NIR$
VI <sub>3</sub>	VI <sub>3</sub>	$ETM_2 / (NIR + RED)$
VI <sub>4</sub>	VI <sub>4</sub>	$ETM_2 - ((NIR + RED) / ETM_2) + (NIR + RED)$
VI <sub>5</sub>	VI <sub>5</sub>	$RED / ETM_7$
VI <sub>6</sub>	VI <sub>6</sub>	$((RED - ETM_7) / (RED + ETM_7)) + 0.5$
VI <sub>7</sub>	VI <sub>7</sub>	$RED * ETM_7 / ETM_5$
VI <sub>8</sub>	VI <sub>8</sub>	$ETM_2 * (RED / ETM_7)$
VI <sub>9</sub>	VI <sub>9</sub>	$ETM_7 / (RED + ETM_5)$
VI <sub>10</sub>	VI <sub>10</sub>	$ETM_2 - ((ETM_5 + ETM_7) / ETM_2) + (ETM_5 + ETM_7)$
VI <sub>11</sub>	VI <sub>11</sub>	$ETM_5 - ((ETM_7 + ETM_2) / ETM_5) + (ETM_7 + ETM_2)$

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+		VI <sub>3</sub>	
+		VI <sub>3</sub>	
+		VI <sub>4</sub>	

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Fuse<sub>4</sub> MIRV<sub>1</sub>

VI<sub>9</sub> VI<sub>6</sub>

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BI

MIRV<sub>1</sub>

					VI <sub>10</sub>	
					PD <sub>312</sub>	
					VI <sub>3</sub>	
					VI <sub>12</sub>	
					ETM <sub>7</sub>	
					VI <sub>6</sub>	
					VI <sub>9</sub>	
					MIRV <sub>2</sub>	
					BI	
					MIRV <sub>1</sub>	
					VI <sub>6</sub>	
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					GVI	
					VI <sub>10</sub>	
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/ **	/	,	/ + VI <sub>3</sub>	VI <sub>3</sub>	
/ **	/	/	/ / VI <sub>12</sub>	VI <sub>12</sub>	
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/ **	/	/	+ VI <sub>6</sub>	VI <sub>6</sub>	
/ *	/	/	/ VI <sub>9</sub>	VI <sub>9</sub>	
/ **	/	/	/ + MIRV <sub>2</sub>	MIRV <sub>2</sub>	
/ **	/	/	/ + MIRV <sub>2</sub>	MIRV <sub>2</sub>	
/ **	/	/	/ + MIRV <sub>2</sub>	MIRV <sub>2</sub>	
/ **	/	/	+ MIRV <sub>1</sub>	MIRV <sub>1</sub>	
/ **	/	/	/ + MIRV <sub>2</sub>	MIRV <sub>1</sub>	
/ **	/	/	/ + / VI <sub>6</sub>	VI <sub>6</sub>	
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/ **	/	/	/ + GVI	GVI	
/ **	/	/	/ / VI <sub>10</sub>	VI <sub>10</sub>	
/ **	/	/	/ / Fuse <sub>2</sub>	Fuse <sub>2</sub>	
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MSAVI<sub>2</sub>

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<sup>1</sup> Curran and Williamson

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MIRV<sub>2</sub>

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ETM<sup>+</sup>

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VI<sub>9</sub> VI<sub>6</sub>  
(RED)

(ETM<sub>7</sub> - ETM<sub>5</sub>)

ETM<sup>+</sup>

GVI

GVI ( )

SARVI

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(VNIR<sub>2</sub>) GNDVI<sub>2</sub>

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## Determination of suitable indices for vegetation cover assessment in summer rangelands in south of Mazandaran

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### Abstract

In order to determine suitable indices for vegetation cover and production assessment based on remote sensing data, simultaneous digital data with field data of summer rangeland in south of Mazandaran province were analyzed. During 3 years monitoring vegetation cover including annuals, grasses, forbs and shrubs and total production data of sixty plots in each site (1 square meters) were collected. The Global Positioning System (GPS), geometric correction, histogram equalization and images digital numbers were converted to reflectance numbers. In the next stage, intrinsic indices, soil-line related indices and atmospheric corrected indices were generated. For determining suitable indices, linear regression model was used. The results showed that there are significant relationships between satellite data and vegetative characteristics. Among indices,  $VI_{10}$  with annual covers,  $VI_6$ ,  $VI_{10}$ ,  $MIRV_1$  with grasses cover,  $PD_{312}$ ,  $VI_9$ ,  $MIRV_1$ ,  $GVI$  indices with forbs cover,  $MIRV_2$ ,  $VI_6$ ,  $VI_{10}$  with shrubs cover,  $VI_{12}$ ,  $MIRV_2$ ,  $VI_5$ ,  $fuse_2$  and total cover and  $MIRV_1$ ,  $MIRV_2$ ,  $VI_5$ ,  $Tgr$  with total production, showed significant relationships. Generally introduced indices presented accurate quantitative estimation of the parameters. Therefore, it is possible to estimate vegetation cover and range production as important factors for range monitoring using landsat  $ETM^+$  data.

**Keywords:** Remote sensing, Vegetation cover, Production, Vegetation index, Mazandaran