Performance of the Food Crops Sector Amidst Pressure from Changes in Land Cover and Fluctuations in Water Discharge in the Konaweha Watershed

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Abstract—*The research aims to analyze the performance of the regional economy and the food crop sector amid pressures from changes in land cover and fluctuations in water discharge in the Konaweha Watershed, Southeast Sulawesi Province, Indonesia. The research data use secondary and primary data (land cover change survey). The database uses annual data (time series) between 2014-2021. Specifically, data on changes in land cover and water discharge in 2021 are compared with primary data (surveys). Regional economic data (GRDP) and food crops use secondary data. The results of the analysis show that the Konaweha Watershed during 2014-2021 experienced changes in land cover with a pattern of decreasing vegetation area and increasing built-up area. Water discharge decreased significantly with extreme decreases starting to occur in 2015, 2016, and 2017, and then starting to show a decrease in 2021. Watershed pressure which is marked by changes in land cover and decreased discharge in turn has an impact on regional economic performance, especially for food crops, horticulture, and plantations. It was found that changes in watershed land cover had significant implications for water discharge (decrease) so it had a negative impact on food availability (food crop commodities, horticultural commodities, and plantation crop commodities, respectively). If the pressure on watershed resources continues, it will have broad consequences (not only on the aspects studied in this study) that are difficult to predict. These results indicate that there is a need for immediate efforts to control this phenomenon in order to ensure food availability in the future.*

Index Terms— ***Land Cover, Water Discharge, Regional Economy*.**

I. INTRODUCTION

Indonesia's agricultural resources are very abundant and contribute greatly to meeting world food needs. For example, rice production ranks third after China and India. Then local corn production dominates Asian production, and soybean is ranked sixth in the world. Apart from estate crops, palm oil (CPO), rubber, cocoa, pepper, and coffee also occupy the first to third positions in the world. All of this shows the comparative advantage of Indonesia's agricultural commodities. With this potential, the agricultural sector is one of the mainstay sectors of the national economy (GDP) [1].

Indonesia's food security in 2019 Indonesia is ranked 62nd with a score of 62.6. This position has increased compared to the position in 2017 with a score of 53.2 and in 2015 with a score of 50.7 while placing Indonesia in the 74th position globally [2]. The challenge is the availability of irrigation water. The only resource that controls the availability and fulfillment of water in general is the Watershed (DAS). States that the watershed as a source of irrigation is in uncertainty, especially climate (rain), this is indicated by the early rainy season the ability of irrigation to lose 30% of the seed, and is projected to have an impact on reducing rice productivity (Case in Cambodia) [3]. It is a fact in Indonesia that the availability of water resources is 66% for irrigation purposes, 17% for households, around 10% for industrial activities, and 7% for urban activities.

The next fact is that the availability of water to supply agricultural irrigation is not evenly distributed throughout Indonesia. This can be seen from the fact that some areas have sufficient water supply and even have a surplus of water supply and in other cases they experience a deficit or not enough to supply agricultural irrigation. Farida et al [4] in his study stated that the condition of Indonesia's water resources in sufficient quantity but not evenly distributed resulted in water deficits in several places, especially Java Island. [5] state that nationally, the resilience (supply) of irrigation water is generally in moderate conditions, some are good and some are very bad. This good condition is because the ratio of water availability is greater than water demand. This is in line with the results of a study by [6] that the amount of available water in Batang Selo, Padang Ganting District, Tanah Datar Regency is large enough so that it can supply all agricultural land in all growing seasons.

Cases in Southeast Sulawesi and specifically in Konawe Regency were disclosed by Baco [7]. His study concluded that the availability of water in the Roraya Watershed, Southeast Sulawesi Province in general (86.6%) is for irrigation needs, so that every year there is a water deficit of 2,897 m3/day of the total water demand for irrigation, domestic, non-domestic and industrial. The phenomenon of insufficient availability of irrigation water for agricultural needs cannot be separated from changes in land cover itself. As a result of the lack of availability of irrigation water, which triggers the conversion of agricultural land to other uses, there has been a decrease in the area of agricultural land, especially paddy fields, as happened in 2013 to 2018. Several studies state that the availability of irrigation water cannot be separated from changes in land cover and changes in land use [8]; [9]; [10].

Along with an increase in population followed by meeting the needs of the consequences of physical changes in the watershed. The most common change in forest land cover occurs with a pattern of decreasing area, and non-forest

expansion [11]; and [12]. The same thing also happened to several other watersheds both in the surrounding area, nationally and even in several other countries (such as Asia and Asean). [13]; and [14] in their study that significant changes in watershed land cover began to occur in the 1990s. Continued Zhai in his study stated that the pressure on watersheds is not only on changes in land cover, but on land ownership conflicts. Changes in watershed land cover for non-forest areas are dominated by built-up land, reaching 93% by [15], [16], [17], and [18]. Changes in watershed land cover cannot be separated from its function because it produces goods and services, especially the quantity, quality and continuity of water (water yield) [19]. It is urgent to answer this, because watersheds are important because almost all human activities depend on agriculture and watersheds.

The Konaweha watershed has been under pressure for a long time. Study in [20], [21]; [22]; and [23] stated that changes in forest land use to non-forest in the Konaweha watershed (upstream) have affected water availability in the Konaweha watershed such as a decrease in the maximum and minimum discharge of the Konaweha River which ultimately affects water availability, especially the monthly distribution which uneven. If the phenomenon of land cover change continues to occur, it will have an impact on the performance of the food crops themselves.

Finally it was found that food crops in Konawe Regency have an important role in the regional economy. Input from this sector is influenced by the availability (discharge) of irrigation water and irrigation itself is correlated with land cover. This then becomes an opportunity for a study to be carried out to reveal the dynamics of the three namely the dynamics of land cover, availability of irrigation water (discharge), and the performance of the food crop sub-sector and regional economy in general in Konawe Regency.

II. MATERIALS AND METHODS

The research takes studies in the Konaweha Watershed to represent the dynamics of land cover changes in the watershed as a water catchment area, water discharge (sourced from the watershed) and the relationship with the regional economy and the role (contribution) of the food crop sector in Konawe Regency. The area of the Konaweha watershed is around 6,978.41 km^2 or around 697,841 ha. This research includes quantitative research using a combination design between field surveys (ground checks) to obtain actual data and information in the field and secondary data collection. This study uses panel data, namely grouping data from a certain time period (time series) and data on several objects observed in the field (cross section). Time series data in this study are land cover change data, availability of irrigation water, and food crop performance data for the 2014-2021 period. Cross section data is data related to the 2021 land cover change data as a cross section of the secondary data obtained.

Monitoring of land cover change in the Konaweha Watershed for 2014-2021 was analyzed using a spatial method using a geographic information system application, with the following stages: a) Classification of satellite imagery for monitoring land cover change. The classification uses Landsat ETM+ imagery for 2006, 2011, 2016 and Landsat imagery for 2021. This process is carried out using the OBIA (Object Based Image Analysis) classification method on SAGA software; and b) Accuracy Test, carried out from the results of matching the classification with the ground check results, using the confusion matrix method. The accuracy test that is calculated is overall accuracy, producer's accuracy, and user's accuracy. The overall accuracy threshold value is 85% [24], [11]; [25], [26]; [27].

The maximum discharge (peak flood, Qmax) will be obtained through calculations carried out at the mouth of the river from the DAS (or Sub-DAS) and is estimated based on the flow coefficient (c), rain intensity (i) which is the same length as the concentration time (Tc), and watershed area (A). Measurement of the minimum discharge (Qmin) can be carried out at the mouth of the watershed or sub-watershed in dry season conditions, when the river discharge is the smallest. The average flow rate (Qav) of a river is an important hydrological quantity as an indicator of the potential of a watershed in storing rainwater that falls into the aquifer to be released slowly in the form of springs or seeps. The Flow Variety Coefficient (KRA) often referred to as the River Regime Coefficient (KRS) is a watershed hydrological characteristic parameter obtained from the comparison between the maximum discharge (Qmax) and minimum discharge (Qmin) or often abbreviated as the Qmax/Qmin parameter [28]. The Annual Flow Coefficient is the ratio between the annual flow thickness (Q, mm) and the annual rainfall thickness (P, mm) in the watershed or it can be said how many percent of rainfall becomes runoff in the watershed. The thickness of the flow (Q) is obtained from the volume of discharge (Q, in units of m^3) from the results of observing [28]. The water discharge for the provision of irrigation water from the Konaweha watershed is analyzed using an arithmetic average approach with commonly used equations such as [29], [30], [31], [32].

$$\mathrm{Q-average} = \frac{Q1+Q2+Q3+\cdots.Qn}{n} \quad (1)$$

The performance of the staple (superior) and non-staple (non-superior) food crop sub-sectors during the year of observation was analyzed using the Location Questient (LQ) technique. Quoted from [33] mathematically the LQ analysis is formulated in the equation:

$$LQ= (V_1^R / V^R) / (V_1 / V) \quad (2)$$

Analyzing the performance (LQ) of each food crop commodity is:

$$LQ= (pi/pt) / (Pi/Pt) \quad (3)$$

The results of LQ calculations can be known with the following provisions: 1) If LQ > 1, is the base/favorite; 2) If LQ < 1, it is non-basic; and 3) If LQ = 1, it is also categorized as non-basic because the business sector and/or the food crop sub-sector in the area is capable of sufficient for the entire

population, but the area is unable to export the food crop sub-sector because the production of the food crop sub-sector limited [33].

III. RESULTS AND DISCUSSION

A. Monitoring of Land Cover Changes in the Konaweha Watershed

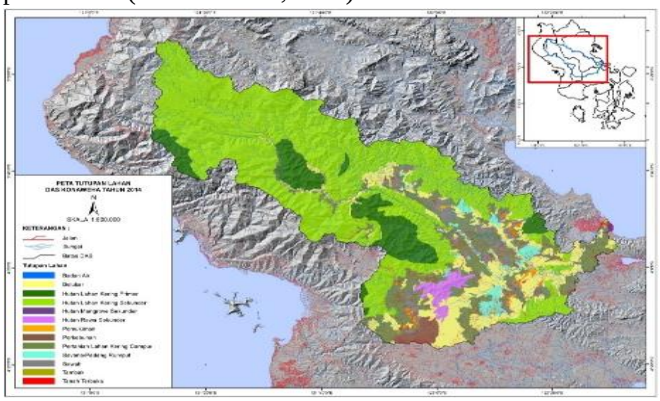
Analysis of changes in land cover is considered as one of the factors that influence water availability, especially for agricultural irrigation in a broad sense. Analysis of land cover change was carried out for 8 (eight) years divided into three observation periods, namely 2014, 2017 and 2021. Land cover change data was analyzed spatially with ArGis software from the latest landsat imagery data. The area of the Konaweha watershed is around 678.908,16 ha, distributed in 13 land cover classes (complete details are presented in Table 1, and Figures 1. The data shown in Table 1 above shows that the area of each land cover class in the Konaweha watershed in the 2014 - 2021 timeframe tends to change, both decreasing in area (vegetated) and increasing in area in the land cover class related to community activities. In fact, changes in the area of land cover occur in all land cover classes, except for water bodies (rivers).

Table 1. Distribution of Konaweha Watershed land cover areas in 2014, 2017, and 2021

Types of Land Cover	Year					
	2014		2017		2021	
	Area (ha)	%	Area (ha)	%	Area (ha)	%
Primary dryland forest	65,984.68	9.72	62,428.26	9.20	58,802.47	8.66
Secondary dryland forest	368,609.89	54.29	366,314.22	53.96	364,116.17	53.63
Mixed dryland agriculture	92,784.30	13.67	98,862.17	14.56	104,221.60	15.35
Plantation	9,050.83	1.33	9,665.51	1.42	10,059.78	1.48
Secondary mangrove forest	536.75	0.08	476.30	0.07	446.91	0.07
Secondary swamp forest	11,995.13	1.77	11,914.55	1.75	11,842.40	1.74
Thicket	85,955.31	12.66	84,908.60	12.51	81,895.54	12.06
Savanna/grassland	12,824.81	1.89	11,842.10	1.74	11,371.55	1.67
Ricefield	23,316.55	3.43	24,360.02	3.59	25,172.00	3.71
Settlement	5,863.31	0.86	6,089.36	0.90	8,670.39	1.28
Ponds	239.43	0.04	299.88	0.04	427.80	0.06
Open land	58.74	0.01	58.74	0.01	193.12	0.03
Water body	1,688.43	0.25	1,688.43	0.25	1,688.43	0.25
Konaweha watershed area	678,908.16	100	678,908.16	100	678,908.16	100

Judging from the area of each class of land cover in 2014, the vegetated land of the Konaweha watershed is still very dominant, around 65.86% of the total area of the watershed. It consists of 54.29% secondary dryland forest, 9.72% primary dryland forest, 1.77% secondary swamp forest and 0.08% mangrove forest. Meanwhile, the class of land cover used for human activities both for settlement and agricultural activities is around 5.68%. This area is obtained from plantations 1.33%, rice fields 3.43%, settlements 0.86%, ponds 0.04%, and open land 0.01%.

In 2017 the distribution of land cover in the Konaweha Watershed was still dominated by the vegetated class, namely 64.91% of the total watershed area (consisting of secondary dryland forest, primary dryland forest, secondary swamp forest and mangroves). The class of land cover used by the community is around 4.54% consisting of 3.59% rice fields, 0.90% settlements, 0.04% ponds, and 0.01% open land. If you look closely, the area of land cover in 2017 shows changes in the area of land cover classes when compared to the area of land cover in 2014. This can be seen from the area of vegetated cover in 2014 to 2017, which decreased by around 0.95% or around 5,993.12 ha. The decrease in the area of vegetated land cover was accompanied by an increase in the area of land utilized by community activities by rice fields, settlements, ponds and open land, namely 1.14% or around 1,329.97 ha. The decrease in vegetated area (forest) between 2014 and 2017 was also followed by an increase in land cover for mixed dryland farming types (0.90% or 6.007.87 ha) and plantations (0.09% or 614,68 ha).



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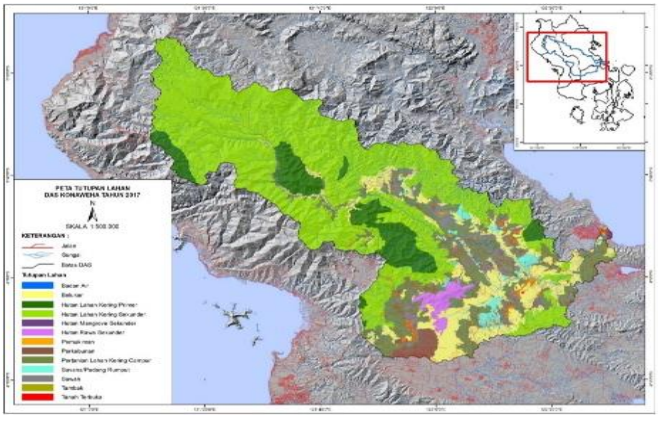

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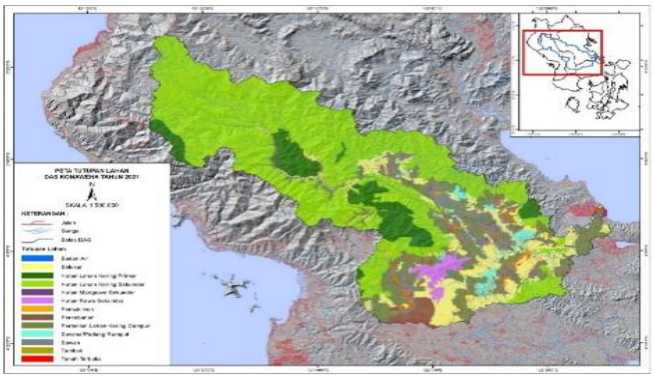

2021

Figure 1. Konaweha Watershed land cover in 2014, 2017, and 2021

Data on changes in the land cover of the Konaweha Watershed between 2014 and 2017, the total change in land cover (increase and decrease in area) of around 2.73% was obtained. It consists of 1.73% which experienced a decrease in land cover area, and 1% land cover class which experienced an increase in area. This means that the rate of decline in the area of vegetated land cover in the Konaweha watershed between 2014 and 2017 was around 1.73%. This 1.73% value represents the rate of decline in forest area or even the rate of deforestation, because deforestation itself is defined as the loss (decrease) of a portion of forest area for the benefit of certain uses.

The area of vegetated land cover in the Konaweha Watershed in 2021 is around 64.10% of the total area of the watershed, while the area covered by the community is around 5.08%. When compared to the percentage of vegetated area in 2017 it showed a decrease of around 0.80% or the equivalent of 5,925.38 ha. As a result of the decrease in the area of vegetated land cover, it has resulted in an increase in the area of other land cover classes, especially those related to utilization activities to support the lives of the surrounding community. The land cover class that experienced an increase in area for rice fields, settlements, ponds and open land was 0.54% or around 3,655.31 ha. Another land cover class that has experienced an increase in area between 2017 and 2021 is mixed dryland agriculture (0.79% or 5,359.43 ha), and plantations (0.06% or 394.27 ha).

The total area of land cover change in the Konaweha watershed in 2017 and 2021 is around 2.77%, slightly higher than the total change in 2014 to 2017 (2.73%). The change in land cover area between 2017 and 2021 looks almost balanced, where it has increased by around 1.39%, while the area has decreased by around 1.38%. The area of decreasing land cover in the Konaweha watershed can indirectly describe the rate of decrease in forest area or even a deforestation rate of 1.38%.

Data on the distribution of vegetated (forested) area in the Konaweha watershed as the widest (dominant) between 2014 (65.86%), 2017 (64.91%), and 2021 (64.10%) are consistent with Warwah research data (2014) that the area of forest land cover in the Konaweha watershed between 1991-2010 was dominated by forests of around 55.17% (the second largest was plantations 34.27%). Then it is in line with the results of the analysis of Andono [22] that between 2000-2010 the forest area was around 66.28%.

The same thing is also shown in the trend of changes in land area which shows a decrease in forest area. Marwah [21] stated that the forest area in 1991 was around 66.60%, in 1999 it was 55.30%, and in 2010 it was 43.60% of the total area of the Konaweha Watershed. This is supported by the study of Andono [22] where the forest area in 2000 was around 68.21%, decreasing to 64.35% of the total area of the Konaweha Watershed. However, there are differences in the rate of decrease in area, in which this study decreased the area of forest land during 2014-2021 around 0.88%, much smaller than the rate of decrease in area by [21] which was 11.50%, even the area of decrease obtained [22] namely 3.86%. This fact indicates that the rate of change (decrease) in forest area in the Konaweha watershed in the 1991-2010 period was higher (extreme), while 2014-2021 tended to be slower.

The same fact also occurs in the plantation land cover class which shows an increase in area. The results of the analysis showed that the increase in plantation area in the Konaweha watershed between 2014-2021 was around 1.00%, while study was around 8.00% [21], and even Andono study increased by around 10.14% [22]. The increase in land cover area for settlements was around 0.21%, which is also in line with the study which showed an increase in area of around 0.35% % [21]. This result is also supported by the results of the analysis of [22] where in the 2000-2010 period there was an increase of around 2.45% of the total area of the Konaweha Watershed. Changes in land use in this study for paddy field cover classes (increased area (3.58%) are also in line with the study which showed an increase in area of around 0.47%. Study [22] showed the same thing where paddy fields increased by around 0.18%. This data informs that the increase in paddy field area in the Konaweha watershed between 1991-1999/2000 tends to be slow, five years later (2014) to 2021 the increase in paddy field area very significant up to four times.

B. River Water Debit Monitoring in the Konaweha Watershed

The analysis of the availability of irrigation water in the study refers to the flow rate data of the river in the Konaweha watershed which supplies irrigation water needs. The flow discharge data used is the result of daily observations throughout 2014-2021 on the Konaweha River with irrigation water intake points at Asolu. The results of measuring the discharge of water passing through the intake as a depiction of the water discharge of the Konaweha watershed are

presented in Figure 2.

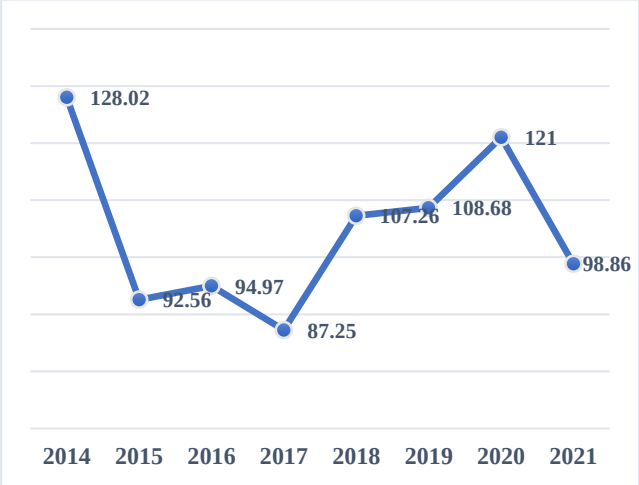

Figure 2. Average water discharge in the Konaweha Watershed in 2014 - 2021

The information above shows that the annual average discharge of the Konaweha watershed during observations shows a decreasing trend. The flow rate in 2014 was 128.02 m3/s, in 2021 it decreased to 98.86 m3/s. An extreme decrease in discharge occurred in 2017. The discharge in 2021 was 98.86 m3/s, experiencing a significant decrease compared to the debits in the previous three years (2020, 2019 and 2018). The above data (highest and lowest discharge) indicate quite extreme hydrological disturbance (highest and lowest discharge during observation). The disturbance is an indication of changes in land use and rainfall (the highest discharge) [34].

Then the change in annual water discharge as shown in Figure 2 is still at a reasonable stage so that the function of water (discharge) as a processor is still functioning properly. This is based on the opinion of Asdak (2010); and Arsyad (2006) [34] that if the amount of average flow rate each year is not much different (during the observation period) this indicates that the watershed as a processor is functioning well, or in other words the characteristics of the watershed or the health of the watershed are still maintained.

From the discharge development data above, it can be said that the water discharge in the Konawe watershed shows a change in the quantity (decrease in the amount) of discharge. This occurs as an implication of changes in land cover as previously disclosed. This fact is in line with several expert opinions that the watershed and the mechanism of water flow (discharge) are very dependent on regional characteristics, namely changes in land use and rainfall (climate) [34]. This fact parallels and/or confirms the results of other studies such as [35], [36], [37]. At the nsame time confirming relevant research (in the Konaweha watershed) by [21]; and [22] stated that the decrease in the area of vegetated land (forest) in the Konaweha watershed is correlated (related) with hydrological conditions (increased surface runoff and maximum discharge when it rains).

C. Performance of the Economic Main-Basic Sector in Konawe Regency

The results of the analysis of LQ Performance of Business Fields that are Basic (Leading) to the regional economy in the GRDP of Konawe Regency at 2010 Constant Prices for 2014-2021 are presented in Figure 3. In accordance with the results of the LQ analysis as presented in Figure 3, it was found that during the last eight years (2014-2021) there were six basic business fields with LQ > 1. The six business fields from the highest were Agriculture, Forestry, and Fisheries (LQ =1.18); Processing Industry (LQ=1.89); Real Estate (LQ=1.47); Government Administration, Defence, and Compulsory Social Security (LQ=1.69); Education Services (LQ=1.20); and Health Services and Social Activities (LQ=1.50).

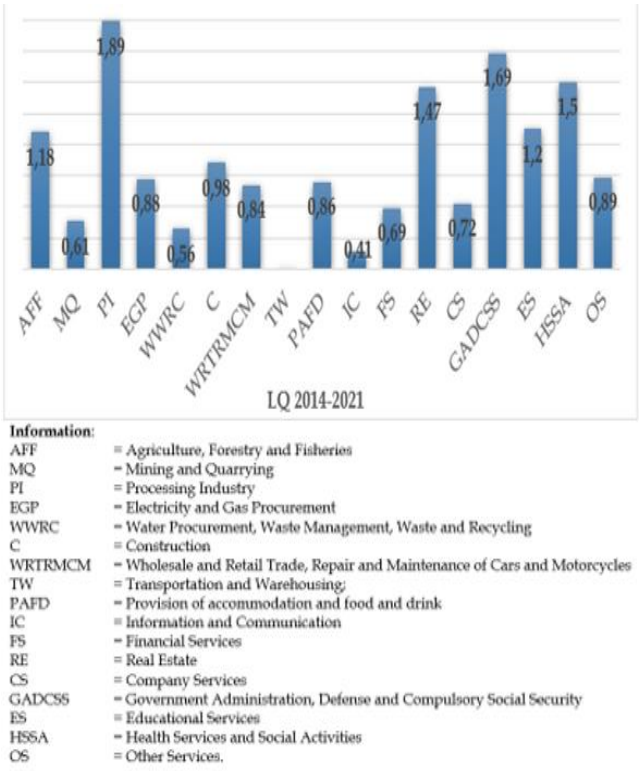

Figure 3. LQ value of business field performance that is base/leading in GRDP of Konawe Regency on the basis of 2010 constant prices in 2014-2021

Judging from the distribution of LQ values throughout 2014-2021 for the Agriculture, Forestry and Fisheries sectors, they consistently play a role as the basis of the economy. Another sector that has a consistent role as a base is Real Estate; Government Administration, Defense, and Compulsory Social Security; as well as Health Services and Social Activities. The six sectors (base) also represent business fields that have a comparative advantage compared to other sectors.

There is no study on the role of business sector in the

regional economy in GRDP based on 2010 prices in Konawe Regency. The only study related to this is by [38] however, the data base is based on 2000 prices with the GRDP observation year 2006-2009. Therefore, it is very weak to compare the results of this study with this study. However, there are similarities between the results of Saleh study and this study, namely the agricultural sector/business field as the basis of the regional economy. With the limitations of relevant studies, the results of this study are able to provide new information (novelty) about the role of sectors/fields of business that are basic and superior in the Konawe Regency economy in the GRDP structure on the basis of 2010 prices. Practical implications of the research findings for policy makers or parties others related to general economic development in Konawe Regency to pay attention (analytical focus) to the six basic business fields as mentioned above.

D. Performance of the Food Sub-Sector in Konawe Regency

The agricultural sub-sector consists of: (1) food crops sub-sector; (2) horticultural crops sub-sector; (3) estate crops sub-sector; (4) livestock sub-sector; and (5) sub-sectors of agricultural services and hunting. Law Number 18 of 2012 concerning Food states that food is everything that comes from biological sources of agricultural, plantation, forestry, fishery, livestock and aquatic products. On this basis, the study of food performance in this study focused on the products or results of food crops, horticulture and estate crops. The database used is the production of each food between 2014-2021. The results of the LQ analysis for food crop commodities for the agricultural sector in the Konawe Regency economy in 2014-2021 are presented in Table 2.

Table 2. Results of LQ analysis of food crop commodities against the agricultural sector in the economy of Konawe Regency in 2014-2021

Food Crops Commodity	*Location Questient* (LQ)								LQ-Average	Note
	2014	2015	2016	2017	2018	2019	2020	2021		
Paddy	1.36	1.36	1.34	1.47	1.51	1.73	1.56	1.36	1.46	Base
Corn	0.11	0.07	0.11	0.44	0.26	0.11	0.27	0.45	0.23	Non-Base
Soybeans	0.64	0.51	0.44	0.31	0.49	1.49	2.28	3.08	1.15	Base
Peanuts	0.07	0.23	0.15	0.17	0.29	0.22	0.15	0.19	0.18	Non-Base
Mung beans	0.21	0.37	0.28	0.52	0.53	0.84	0.31	0.47	0.44	Non-Base
Cassava	0.11	0.17	0.18	0.12	0.15	0.15	0.11	0.25	0.15	Non-Base
Sweet potato	0.15	0.36	0.34	0.41	0.60	0.47	0.28	0.34	0.37	Non-Base

Based on the results of the LQ analysis, it is known that the food crop commodities of Konawe Regency during 2014-2021 which are basic (LQ value > 1) are two commodities, namely Paddy (LQ=1.46) and Soybeans (LQ=1.15). The rice commodity is consistent with its role as a basic commodity in the regional economy of Konawe Regency. Soybeans as a base commodity will begin to occur in 2019, until 2021. It can be concluded that of the seven commodities, only two play an important role and have a comparative advantage in the agricultural sector and in the economic structure of the Konawe Regency region.

In accordance with the availability of horticultural crop data collected from secondary sources for 2014-2021 it consists of two types of commodities, namely vegetables and fruits. There are twelve (12) types of vegetable commodities in Konawe Regency in 2014-2021, while there are 19 types of fruits. The results of the analysis (with LQ) of the role of horticultural crops for types of vegetables in the regional economy are presented in Table 3. Then the results of the LQ analysis for types of fruits are presented in Table 4.

Based on the LQ values in Table 3 above, it is found that between 2014-2021 only four (4) commodities are the basis, while the other eight (8) are non-base. The four commodities are large chilies (LQ=3.02); Chickpeas (LQ=2.49); Petsai (LQ=1.46); and long beans (LQ=1.11). Then it was found that chili plays a large role as a consistent basis throughout the year of observation (2014-2021). The vegetable commodity which acts as the base illustrates its comparative advantage in the regional economy, where chili has more advantages than other basic commodities.

Table 3. Results of LQ analysis of vegetable commodities against the agricultural sector in the economy of Konawe Regency in 2014-2021

Vegetable Commodities	*Location Questient* (LQ)								LQ-Average	Note
	2014	2015	2016	2017	2018	2019	2020	2021		
Onion	1.27	1.12	0.72	0.28	0.48	1.02	0.92	0.94	0.84	Non-Base
Spinach	0.36	0.36	0.24	0.17	0.47	0.73	0.75	0.76	0.48	Non-Base
Beans	6.70	7.12	2.99	0.19	0.81	0.83	0.62	0.65	2.49	Base
Big shili	1.35	1.64	6.31	3.54	3.73	2.83	2.06	2.71	3.02	Base
Cayenne pepper	0.67	0.84	0.32	1.57	1.12	1.30	1.18	1.20	1.03	Non-Base
Long beans	1.07	1.15	0.95	0.92	1.24	1.21	1.26	1.06	1.11	Base
Water spinach	0.39	0.35	0.26	0.22	0.21	0.34	0.53	0.46	0.35	Non-Base
Cucumber	1.06	0.79	0.62	0.75	0.76	1.18	1.37	0.89	0.93	Non-Base
Chayote	0.32	0.25	0.21	0.10	0.15	0.18	0.05	0.09	0.17	Non-Base
Petsai	2.26	1.75	2.74	0.39	0.87	1.24	1.20	1.20	1.46	Base
Fight	1.30	1.32	1.27	0.90	1.01	0.85	0.81	0.85	1.04	Non-Base
Tomatoes	1.03	1.08	0.75	1.49	1.26	0.85	0.91	0.88	1.03	Non-Base

Table 4 shows that there were four fruit commodities in Konawe Regency during 2014-2021 which were basic (LQ > 1), namely Duku/Langsat (LQ=4.86), Durian (LQ=5.45), Mango (LQ = 1.25), and rambutan (LQ = 1.22). The four basic types of fruit have the largest amount of production among other types of fruit, including the percentage at the Southeast Sulawesi Province level. The respective contributions are Duku 59.44%; Durians 82.47%; Manga about 18.49%, and Rambutan contributed about 40.88%. Therefore, these four types of fruit are superior (comparative advantage) in the regional economy in Konawe Regency, especially in the agricultural sector.

Table 4. Results of LQ analysis of fruit commodities against the agricultural sector in the economy of Konawe Regency in 2014-2021

Fruit Commodities	*Location Questient* (LQ)								LQ-Average	Note
	2014	2015	2016	2017	2018	2019	2020	2021		
Melon	0.12	0,38	0,27	1,48	1,23	0,82	1,44	0,52	0.78	Non-Base
Watermelon	0.29	1,12	0,27	1,11	2,03	0,80	1,18	0,92	0.96	Non-Base
Avocado	0.03	0,11	0,03	0,28	0,29	0,14	0,33	0,18	0.17	Non-Base
Star fruit	0.28	0,61	0,17	0,14	1,91	0,61	0,15	0,02	0.49	Non-Base
Duku/Langsat	1.90	4,59	2,36	13,99	4,80	4,89	3,48	2,88	4.86	Base
Durian	5.10	3,19	24,05	3,58	0,66	2,17	2,75	2,11	5.45	Base
Water apple	3.83	0,95	0,05	0,20	0,30	0,20	0,24	0,13	0.74	Non-Base
Guava	0.25	0,23	0,09	0,15	0,28	0,29	0,02	0,13	0.18	Non-Base
Big orange	0.10	0,42	0,12	0,39	0,29	0,50	1,28	0,60	0.46	Non-Base
Siamese orange	0.09	0,20	0,04	0,24	0,89	0,69	1,70	2,63	0.81	Non-Base
Mango	1.02	0,40	2,56	0,58	2,25	0,76	1,09	1,35	1.25	Base
Jackfruit	0.31	0,54	0,14	0,70	1,42	1,19	0,81	0,60	0.71	Non-Base
Pineapple	0.40	0,10	0,71	0,20	0,16	0,25	0,05	0,03	0.24	Non-Base
Pawpaw	0.99	0,13	0,38	0,65	0,67	0,46	0,19	0,17	0.46	Non-Base
Banana	0.07	0,92	0,71	1,41	0,75	0,36	0,21	0,25	0.58	Non-Base
Rambutans	2.42	2,45	0,29	0,37	0,37	0,61	1,73	1,53	1.22	Base
Snakefruit	0.35	0,67	0,33	2,13	1,27	0,51	0,15	0,27	0.71	Non-Base
Soursop	0.20	0,19	0,04	0,15	0,18	0,14	0,09	0,03	0.13	Non-Base
Breadfruit	0.08	0,87	0,19	1,87	0,55	0,24	0,45	0,63	0.61	Non-Base

There are eight types of plantation commodities in Konawe Regency which are presented (secondary source) production data for 2014-2021 as presented in Table 5. Based on the results of the LQ analysis it is known that plantation crop commodities which play an important role in plantations at the provincial level are Sago, Coffee, and Pepper (has a value of LQ = >1).

Table 5. Results of LQ analysis of plantation commodities against the agricultural sector in the economy of Konawe Regency in 2014-2021

Plantation Commodities	*Location Questient* (LQ)								LQ-Average	Ket.
	2014	2015	2016	2017	2018	2019	2020	2021		
Palm oil	0.70	1.44	1,22	0,51	0,22	0,44	0,92	1.99	0.93	Non-Base
Coconut	0.76	0.73	0,62	0,67	0,59	0,49	0,62	0.61	0.64	Non-Base
Sago	7.31	6.86	7,66	9,22	9,15	7,96	7,46	8.83	8.06	Base
Coffe	0.66	1.76	2,85	0,49	0,51	1,34	1,74	1.81	1.39	Base
Cacao	0.89	1.03	0,94	1,10	1,13	1,11	1,18	1.03	1.05	Non-Base
Pepper	3.40	1.55	3,26	2,90	2,68	3,19	2,78	3.47	2.90	Base
Cashew	1.26	0.77	0,90	0,66	0,71	0,55	0,53	0.63	0.75	Non-Base
Clove	0.15	0.08	0,16	0,11	0,10	0,06	0,12	0.12	0.11	Non-Base

The role of the base commodities for Sago and Pepper is consistent throughout 2014-2021, in fact both have the largest LQ values compared to other base commodities. The very large LQ value of Sago (LQ=8.06) cannot be separated from the large production contribution to the province, namely 72.10%. This means that Sago production in Konawe Regency during 2014-2021 is around 72.10% of Southeast Sulawesi's total sago production. Pepper as a base commodity (LQ=2.90) contributes around 20% to Southeast Sulawesi's total production. Finally it was found that only three commodities have a comparative advantage in the economy of the special region contributing to the agricultural sector.

Based on the data above, important information is obtained about the role or contribution of each food crop commodity (food crops, horticultural crops and estate crops) to the Agriculture, Forestry and Fisheries sectors as presented in Table 2 to Table 5. Quantitatively (quantity), basic/superior commodities are relatively low compared to total commodities in each type. The second information is that there is dynamics, which is shown by the shift in the role of the basis between years. This assumes that there is an important role (input) that causes this, as well as represents events in the future.

Information on the performance of food commodities (food crops, horticulture and plantation crops) in Konawe Regency has never been presented by other studies, so these results provide new information. In this position, the findings of this study are very urgent, especially in predicting future events as well as the basis for development planning, especially in efforts to maintain food availability and security.

E. The Effect of Changes in Land Cover, Water Debit, and Food Subsector Performance

Analysis of the effect of land closure and release on food (food crop commodities, horticulture and plantation crops) is needed to determine the pattern of relationship (influence) of the three. Efforts made to strengthen the findings or results that have been reviewed above. The analysis used with SEM (Structural Equation Model). The results of the path analysis of the three relationships are presented in Table 6.

Table 6. Path Coefficient

Path Coefficients	*Oroginal Sample (O)*	*Sample Mean (M)*	*Standard Deviation (STDEV)*	*T Statistics (O/STDEV)*	*P Value*
Debit- Food Commodities	*-0.625*	*-0.616*	*0.168*	*3.711*	*0.000*
Debit- Vegetable Commodities	*0.603*	*0.626*	*0.249*	*2.424*	*0.016*
Debit- Plantation Commodities	*-0.801*	*-0.794*	*0.160*	*5.018*	*0.000*
Land cover- Debit	*0.692*	*0.709*	*0.070*	*9.938*	*0.000*

Based on these criteria, the effect of land cover on water discharge has a positive and significant value (0.000) so that land cover has a significant positive effect on water discharge. Then the respective water discharge for food commodities, vegetables, and plantation crops has a significant value of 0.000 so that the water discharge has a significant effect on food commodities, vegetables, plantation crops. This result

reinforces several previous theories and reinforces the results of the research as reviewed above that changes in cover directly impact water discharge (decrease), and water discharge has an impact on decreasing food production.

CONCLUSIONS

The results of this study have provided important information that the Konaweha Watershed as a source of irrigation (water catchment area) has experienced pressure marked by changes in land cover, especially forests (decrease). Our next result is that there is a decrease in water discharge, this confirms (justifies) the general theory that physical changes in the watershed (land cover) have an impact on hydrological conditions. The interesting thing is that changes in land cover in the Konaweha watershed followed by a decrease in water discharge have resulted in low regional economic performance, especially in the food crop sector (water as input). To strengthen our findings, a correlation test was then performed which showed that changes in land cover had a significant effect on water discharge, and water discharge had a significant effect on (productivity) of food crops, respectively in food crops, horticulture and plantation crops.

The data base used is a time series, so these findings can be used as a basis for predicting future events, at least in 2028. If there is no strategic approach (intervention) to overcome and/or minimize the phenomenon in question, then the dynamics (decrease) will occur with the same pattern and magnitude in 2028. When this occurs, it will have wide-ranging consequences (not only on the aspects studied in this study) which are difficult to predict. It is important at this time that efforts are needed as soon as possible to overcome this. The purpose of this, there needs to be further studies to formulate a strategy model to overcome the problem in question.

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REFERENCES

1. Maharani DC. "Mencapai ketahanan pangan Indonesia berkelanjutan". *Global & Policy*, vol. 4 no.2, pp.73-82. December 2016.
2. Badan Ketahanan Pangan, Kementerian Pertanian "Indeks ketahanan pangan indonesia 2018". Jakarta: Kementerian Pertanian. 2018.
3. Horton AJ, Triet NVK, Hoang LP, Heng S, Hok P, Chung S, et al. "The Cambodian Mekong floodplain under future development plans and climate change". Nat. Hazards Earth Syst. Sci. [Internet] 2022 [cited 2023 Jan 21]. Available from: https://nhess.copernicus.org/articles/22/967/2022/
4. Farida F, Dasrizal D, Febriani T. "Review: Produktivitas Air dalam pengelolaan sumber daya air pertanian di Indonesia". J. Spasial [Internet] 2019 [cited 2023 Jan 21]; vol. 5, pp. 65–72. Available from: http://ejournal.stkip-pgri-sumbar.ac.id/index.php/spasial/article/view/3161
5. Hatmoko W, Radhika R, Firmansyah R, Fathoni A. "Ketahanan air irigasi pada wilayah sungai di Indonesia". *J. Irig*. [Internet] 2018 [cited 2023 Jan 21];12:65. Available from: http://jurnalirigasi_pusair.pu.go.id/index.php/jurnal_irigasi/article/view/196
6. Saputra F. "Analisis ketersediaan dan kebutuhan air irigasi untuk pertanian di Kecamatan Padang Ganting Kabupaten Tanah Datar". *Jurnal Buana*, vol. 2 no. 2, pp.584-596. 2018.
7. Baco, S.L., Kahirun., Hasani, U.O., Jalil, A. "Analisis ketersediaan dan kebutuhan air di Daerah Aliran Sungai Roraya Provinsi Sulawesi Tenggara". *Ecogreen*, vol.3 no. 1, pp. 1-8. April 2017.
8. Salim AG, Dharmawan IWS, Narendra BH. "Pengaruh perubahan luas tutupan lahan hutan terhadap karakteristik hidrologi DAS Citarum Hulu". *J. Ilmu Lingkung*. vol. 17 no. 2, pp 333-340. Jan 2019. https://ejournal.undip.ac.id/index.php/ilmulingkungan/article/view/22738.
9. Ismail A, Kusratmoko E, Sobirin. "Pemodelan perubahan penggunaan lahan dan pengaruhnya terhadap koefisien aliran pada daerah tangkapan air Waduk Darma, Kabupaten Kuningan, Provinsi Jawa Barat. *Jurnal Ilmu Kehutnanan, Wanakarsa*, vol. 9 no. 2, pp.1-14. 2015. [cited 2023 Jan 21]. Available from: https://osf.io/rhtz8.
10. Saraswati GF, Suprayogi A, Amarrohman FJ. "Analisis perubahan tutupan lahan das blorong terhadap peningkatan debit maksimum Sungai Blorong Kendal". *Jurnal Geodesi Undip*. vol. 6 no 2, pp. 90-98. June 2017.
11. Piao Y, Jeong S, Park S, Lee D. "Analysis of land use and land cover change using time-series data and random forest in North Korea. *J. Remote Sens*. vol. 13, 3501, pp. 1-19. Sep. 2021. [cited 2023 Jan 21]. Available from: https://www.mdpi.com/2072-4292/13/17/3501
12. Hasddin H, Taufik T, Mukaddas J. "Tingkat perubahan tutupan lahan (deforestasi) di DAS Tiworo Kabupaten Muna Barat". *Sang Pencerah J. Ilm. Univ. Muhammadiyah Buton*. vol. 7 no. 2. May 2021. [cited 2023 Jan 21]. Available from: https://jurnal-umbuton.ac.id/index.php/Pencerah/article/view/1106
13. Zhai J, Xiao C, Feng Z, Liu Y. "Spatio-temporal patterns of land-use changes and conflicts between Cropland and Forest in the Mekong River Basin during 1990–2020. J. Land, vol. 11 no. 6, June 2022. [cited 2023 Jan 21]. Available from: https://www.mdpi.com/2073-445X/11/6/927
14. Mathewos M, Lencha SM, Tsegaye M. "Land *Use and Land Cover Change Assessment and Future Predictions in the* Matenchose Watershed, Rift Valley Basin, Using CA-Markov Simulation". *J. Land* vol. 11, no. 10, 1632. 2022 [cited 2023 Jan 21]. Available from: https://www.mdpi.com/2073-445X/11/10/1632.
15. Guo X, Ye J, Hu Y. "Analysis of land use change and driving mechanisms in Vietnam during the Period 2000–2020. *J. Remote Sens*. vol. 14, 1600. March 2022. [cited 2023 Jan 21]. Available from: https://www.mdpi.com/2072-4292/14/7/1600.

16. Ye J, Hu Y, Zhen L, Wang H, Zhang Y. "Analysis on land-use change and its driving mechanism in Xilingol, China, during 2000–2020 Using the google earth engine". J. Remote Sens. vol. 13, 5134. Dec. 2021. [cited 2023 Jan 21]. Available from: https://www.mdpi.com/2072-4292/13/24/5134
17. Fan, Z., Li, S.; Fang, H. "Explicating the mechanisms of land cover change in the New Eurasian Continental Bridge Economic Corridor region in the 21st century. *J. Geogr. Sci*. 2021, 31, 1403.
18. Hu Y, Hu Y. "Land cover changes and their driving mechanisms in central Asia from 2001 to 2017 Supported by Google Earth Engine. *J. Remote Sens*. vol. 11, 554. 2019 [cited 2023 Jan 21]. Available from: https://www.mdpi.com/2072-4292/11/5/554
19. Hasddin. "Valuasi ekonomi sumberdaya alam pada DAS Tiworo Kabupaten Muna Barat, J. Akran Juara. vol. 4, no. 2, pp. 115-125. May 2019.
20. Baco, S.L., Sinukaban, N., Purwanto, Y.J., Sanim, B., & Tarigan, S.D. "Pengaruh perubahan penggunaan lahan terhadap kondisi hidrologi DAS Konaweha Hulu Provinsi Sulawesi Tenggara. *Jurnal Agroteknos*, vol. 1, no. 3, pp.163-172. 2011.
21. Marwah S. "Analisis perubahan penggunaan lahan dan ketersediaan sumberdaya air di DAS Konaweha Propinsi Sulawesi Tenggara. *Jurnal Agroteknos*, vol. 4, no. 3, pp. 208-218. Nop. 2014.
22. Andono R, Limantara LM, Juwono PT. "Studi penilaian indikator kinerja DAS Konaweha akibat perubahan tata guna lahan berdasarkan kriteria hidrologis. J. Teknik Pengairan, vol. 5 no. 1, pp. 54-60, May 2014.
23. Surya RidwanA, Purwanto MYJ, Sapei A, Widiatmaka W. "Pengembangan kebijakan pengelolaan air baku berkelanjutan di Sub DAS Konaweha Kabupaten Konawe Sulawesi Tenggara. *J. Anal. Kebijak. Kehutan*an. vol. 12, no. 3, pp. 263-282. Dec. 2015. [cited 2023 Jan 21]. http://ejournal.forda-mof.org/ejournal-litbang/index.php/JAKK/article/view/1273
24. Zulkarnain., Halili., L. Diara. "Analisis spasial perubahan tutupan lahan pada wilayah pertambangan (Studi Kasus di areal bekas tambang PT. Bumi Konawe Abadi Kecamatan Motui Kabupaten Konawe Utara). J. Ecogreen, vol. 1, no. 2, pp. 11-24. Octo. 2015.
25. Nedd R, Light K, Owens M, James N, Johnson E, Anandhi A. "A Synthesis of land use/land cover studies: definitions, classification systems, meta-studies, challenges and knowledge gaps on a global landscape. *J. Land*, vol. 10, 994, pp. 1-30. Sep. 2021. [cited 2023 Jan 21];10:994. Available from: https://www.mdpi.com/2073-445X/10/9/994
26. Macarringue LS, Bolfe ÉL, Pereira PRM. Developments in Land Use and Land Cover Classification Techniques in Remote Sensing: A Review. J. Geogr. Inf. Syst. vol. 14, pp. 1-28. Feb. 2022 [cited 2023 Jan 21]. https://www.scirp.org/journal/doi.aspx?doi=10.4236/jgis.2022.141001
27. Tang Y, Chen F, Yang W, Ding Y, Wan H, Sun Z. "Elaborate monitoring of land-cover changes in cultural landscapes at heritage sites using very high-resolution remote-sensing images". *J. Sustainability*, vol. 14, 1319, pp. 1-18. Jan. 2022. [cited 2023 Jan 21]. Available from: https://www.mdpi.com/2071-1050/14/3/1319.
28. Mbungu WB, Kashaigili JJ. "Assessing the hydrology of a data-scarce tropical watershed using the soil and water assessment tool: Case of the Little Ruaha River Watershed in Iringa, Tanzania. *Open J. Mod. Hydrol*. vol. 7, pp. 65-89. March 2017. [cited 2023 Jan 21]. Available from: http://www.scirp.org/journal/doi.aspx?DOI=10.4236/ojmh.2017.72004.
29. Bruijnzeel (2004) Bruijnzeel. (2004). "Hydrological functions of tropical forests: not seeing the soil for the trees? *Agriculture, Ecosystems & Environment*, vol. 104, no. 1, pp. 185-228. 2004. https://doi.org/10.1016/j.agee.2004.01.015.
30. Dhakal B. "The local environmental, economic and social tragedies of international interventions on community-based forest management for global environmental conservation: A critical evaluation. *Open Journal of Forestry*, vol. 4, no. 1, pp. 58–69. Jan. 2014. https://doi.org/10.4236/ojf.2014.41010: http://www.scirp.org/journal/doi.aspx?DOI=10.4236/ojf.2014.41010.
31. Sukri AS, Balany F. "Studi optimalisasi opersi pembagian air pada jaringan irigasi wawotobi Kecamatan Unaaha Kabupaten Konawe (Studi kasus: jaringan irigasi BW1 – B UN. 5 TG). *J. Civ. Eng*. vol. 3, pp. 27-34. Nov. 2017.
32. Jasman. "Analisis ketersediaan air irigasi dan model pola tanam dalam pengembangan potensi lahan pertanian padi sawah di Kabupaten Konawe". *Jurnal Akrab Juara*, vol. 4, no. 2, pp. 123-139. Mei 2019.
33. Hasddin., Muthalib, A.A., Ngii, E., & Putera, A. (2022). "*Metode Analisis Perencanaan dan Pembangunan (Paradigma Penelitian, Data Kuantitatif-Kualitatif, Analisis Kependudukan dan Sosial, & Analisis Ekonomi Wilayah*)". Bandung: Penerbit Media Sains Indonesia, pp 1-80. Nov. 2022. [cited 2023 Jan 21]. https://books.google.co.id/books/about?id=GFGeEAAAQBAJ.
34. Paimin., Pratiwi., Santoso H. "*Sistem perencanaan pengelolaan daerah aliran sungai*". Bogor: Kementerian Kehutanan, Badan Penelitian dan Pengembangan Kehutanan, Pusat Penelitian dan Pengembangan Konservasi dan Rehabilitasi. 2012 [cited 2023 Jan 21].https://hdl.loc.gov/loc.gdc/gdcebookspublic.201233 0829
35. Nathania S, Fatimah E, Suharto BB. "Efforts to reduce river water discharge through land use control (Case Study: Upstream Ciliwung Watershed, Indonesia). *J. Appl. Geospatial Inf.* vol. 6, no. 2, pp. 674-680. Nov. 2022. [cited 2023 Jan 21]. Available from: https://jurnal.polibatam.ac.id/index.php/JAGI/article/view/4730.
36. Heryani N, Kartiwa B, Sosiawan H, Rejekiningrum P, Adi SH, Apriyana Y. "Analysis of climate change impacts on agricultural water availability in Cimanuk

Watershed, Indonesia. *J. Sustainability*, vol. 14,16236. Dec. 2022. [cited 2023 Jan 21]. Available from: https://www.mdpi.com/2071-1050/14/23/16236.

37. Amichiatchi NJMC, Soro GE, Hounkpè J, Goula Bi TA, Lawin AE. "Evaluation of potential changes in extreme discharges over some watersheds in Côte d'Ivoire. *J. Hydrology*, vol. 10, no. 6, pp. 1-16. Dec. 2022. [cited 2023 Jan 21]. Available from: https://www.mdpi.com/2306-5338/10/1/6.
38. Saleh, L. "Penentuan sektor ekonomi unggulan dan pengembangan sub sektor unggulan pertanian terhadap ketahanan ekonomi daerah di Kabupaten Konawe Sulawesi Tenggara. *Agritech*, vol. 17, no. 1, pp. 73-86. June 2015.