water & sanitation

Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

RESERVE DETERMINATION STUDIES FOR SELECTED SURFACE WATER, GROUNDWATER, ESTUARIES AND WETLANDS IN THE USUTU/MHLATUZE WATER MANAGEMENT AREA
WP 10544

MACRO-ECONOMIC AND SOCIO-ECONOMIC ASSESSMENT OF THE USUTU TO MHLATUZE CATCHMENT

FINAL REPORT
JANUARY 2016

Report No. RDM/WMA6/CON/COMP/0413

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DEPARTMENT OF WATER & SANITATION

CHIEF DIRECTORATE: WATER ECOSYSTEMS

CONTRACT NO. WP 10544

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This report should be cited as:

Department of Water & Sanitation (DWS) 2016. Chief Directorate – Water Ecosystems: Reserve determination study of selected surface water and groundwater resources in the Usutu/Mhlathuze Water Management Area. Macro-Economic and Socio-Economic Assessment of the Usutu to Mhlatuze Catchment**.** Prepared by Tlou Consulting (Pty) Ltd and Conningarth Economists. Report no: RDM/WMA6/CON/ COMP/0413.

Contract Title: Reserve determination studies for selected surface water, groundwater, estuaries and wetlands in the Usutu - Mhlathuze Water Management Area

Report Title: Macro-Economic and Socio-Economic Assessment of the Usutu to Mhlatuze Catchment

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Revision	**Date**	**Report Status**
Draft 1.0	10 May 2015	Draft for internal comment
Draft 1.1	15 December 2015	For Client comment
Final	30 January 2016	Final

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1 INTRODUCTION AND CONTEXT

1.1 Background

People are dependent on natural resource for their physical, economic and social well-being. One of these natural resource is the water resources and the environmental flows in a catchment. An environmental flow is the water regime provided within a river, wetland or coastal zone to maintain ecosystems and their benefits where there are competing water uses and where flows are regulated. Environmental flows provide critical contributions to river health, economic development and poverty alleviation. They ensure the continued availability of the many benefits that healthy river and groundwater systems bring to society. They are reliant on ecosystems for food, water, energy and other goods. Nature also provides services such as erosion control, water purification, and pollination that maintain a resilient and productive environment (see Table 1 for a full list and definitions of ecosystem services). In addition, humans derive ethical services such as recreation and spiritual well-being from nature. It is becoming increasingly clear that population growth, demographic changes in different regions of the country and economic development are leading to rapid changes in South Africa's national ecosystems and their functioning. Since 2001, the Millennium Ecosystem Assessment (MEA) has worked to assess the consequences of ecosystem change for human well-being, and establish the scientific basis for actions needed to enhance the conservation and sustainable use of those ecological systems, so that they can continue to supply the services that underpin all aspects of human life.

Besides the need for ensuring sustainable functioning of the natural ecosystems, there is a need to balance with the economic imperatives of the communities who are also dependent on the same water resource.

Water is a non-market good, private in nature but with great public goodness associated with it. Attaching a value to water will assist water managers with tariff setting for redistribution of water resources, the determination of socially optimal water resources and the construction of policy interventions over time to balance the needs for sustainable ecosystem functioning while enabling the socio-economic growth and development of areas. To achieve this it is necessary to attach an economic value to a non-market good.

This report describes the findings of the assessment of the economic value of the Usutu to Mhlathuze Catchments based on the current available water allocations as well as an overview of the socio-economic importance of the ecosystem services and function in the catchments. The results produced from the model will be divided between the once-off situation where water supply will be reduced when the policy is applied and on the other hand results provided in time span of five years where water supply will be reduced in the sectors affected by the policy where the chosen scenario will be used.

1.2 Context

1.2.1 The valuation of economic activities dependent on the water resources

The valuation of the economic activities which are dependent on the water resources of catchments is based on the assumption that the water is removed from the source, the river and used within and/or outside of the catchments to generate products for sale to the communities in the region or outside of the catchment. This applies to a number of economic activities:

- Irrigation Agriculture;
- Commercial Forestry;
- Mining;
- Heavy Industry, including saw, pulp and sugar mills;
- Domestic Water.

An additional one is added, eco-tourism, which depends on the water in the source, but the economic impacts take place outside of the source. In the case of game parks the game viewing is mostly around the rivers. If the rivers are not in a healthy and good condition the tourists will stay away. The same applies for the beaches.

There is also other water based tourist activities that contribute to the sense of place experience that the eco-tourists want to experience.

1.2.2 The need for socio-economic valuation of ecological goods and services

The socio-economic valuation of ecosystem services supports ecological water requirements policy and implementation in various ways. First, it can reveal the economic costs and benefits of water use of different types of uses. For instance, the costs and benefits of eco-tourism and economic development benefits from water resources can be compared with those of sustainable management rivers, wetlands and estuaries in the catchments. In this way, it can also show the trade-offs in water resource management, i.e., the economic benefits lost and gained, and the stakeholders benefiting and losing from different uses of the water resources in the catchments.

Second, it can show the interests of different groups of stakeholders in water and ecosystem management, thereby providing a basis for conflict resolution and integrated, participatory planning of resource management.

Third, the approach allows calculation of economic efficient water resource management options, for instance the calculation of the optimal degree of pollution control in a river ecosystem that is used both as waste outlet for local industries and for water supply, fishing and recreation.

1.2.3 Valuation of ecological Goods & Services

The purpose in valuing ecological goods and services is to illicit measures of human preference for or against environmental change. The objective of sustainable development and management of water resources in the Usutu to Mhlathuze Catchment almost certainly cannot be interpreted without some

idea of the value of ecological services and assets provided by the river systems in the Usutu-Mhlathuze Catchments.

There are different products and services provided by the water resources. The water supply taken out of the system is used for the production in the primary, secondary and tertiary sectors. However the water resources left in river system has significant value as it generates ecological goods and services. The ecological goods and services provided by the Letaba River include the following associated costs and benefits for but is not limited to the following:

- Use of rivers for social and cultural activities by communities within the Usutu – Mhlathuze Catchments
- Floodplain agriculture (including cattle grazing along the banks) by communities in the Lower Pongola River system in particular
- Recreational activities from storage reservoirs in the Usutu – Mhlathuze Catchment. This links with the eco-tourism which is a major economic activity in the catchment including the coastal plains
- Costs of illness and human capital due to waterborne diseases such as diarrhoea, cholera and Bilharzia.
- Waste assimilation of Usutu – Mhlathuze Catchment
- Value of maintenance of wetlands in the Usutu – Mhlathuze Catchment.

1.2.4 Total valuation

The value of the use of water for economic growth and development and for the ecological goods and services provide have been determined for the current allocation status.

1.3 Task Objective

The socio-economic assessment is one the tasks being undertaken which will provide input into the Reserve determination of the Usutu – Mhlathuze catchments and provide a tool to undertake the trade-off between economic development for the wellbeing of communities in the catchments in terms of use of the resource for economic growth and development of the region, and ecological water requirements for sustainable ecosystems functioning. There are two areas of the socio-economic assessment that have been conducted, (i) the economic benefits of water use for economic growth and development; and (ii) the socio-economic benefits of the ecological goods and services (EGS).

1.3.1 Macro-economic assessment of water use

The objective of the macro-economic assessment of water use in the Usutu to Mhlathuze catchments is therefore to undertake a value estimation of the current use of the water by the economic activities in the catchments. This will act as a baseline against which all identified scenarios can be tested and the impact of the scenario will be quantified.

The current results will be expressed in terms of the following macro-economic indicators, namely:

- Gross Domestic Product (GDP) – this is an economic growth indicator. It will be presented in Direct, Indirect/Induced and Total impact.
- Employment – direct employment emphasises the importance of the economic activity in the specific area. It will be presented in Direct, Indirect/Induced and Total impact.
- Payments to Households – payments to low income households together with direct employment is good indicator of the specific economic activity's contribution to poverty alleviation in a local area. It will be presented in Low Income, Medium/High and Total Household payments.

2 APPROACH TO THE ECONOMIC ASSESSMENT OF THE USUTU TO MHLATHUZE RIVER SYTEM

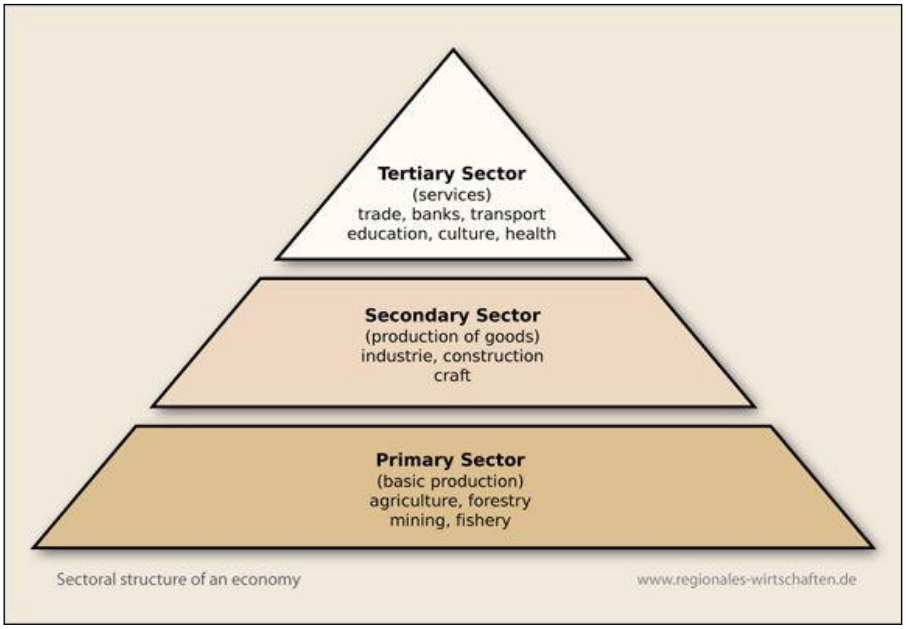
2.1 Approach to the Economic assessment of abstracted water from the rivers

2.1.1 Economic Structure

The economic baseline provides the impacts of water usage when the full water allocation is available in the respective Economic Regions or catchments for variables such as Gross Domestic Product (GDP), employment, and income received by low income households.

To accomplish this economic baseline, an econometric model has been constructed with the multipliers synthesised from the representative KwaZulu–Natal Provincial Social Accounting Matrix (SAM) for the WMA-area, as basis. The Water Impact Model (WIM) was used for the primary sectors such as irrigation agriculture, commercial forestry and mining and adapted to be applied to the secondary and tertiary sectors.

A broad schematic representation of the structure of the different sectors of the economy is shown below.



The important factor in the economic status quo is the dependence of some of the major secondary industries in the WMA on the primary production sector:

- Commercial Forestry:
  - Sawmills;
  - Pulp factories; and
  - Wood chip units.
- Sugar cane – sugar mills.

The model, as is currently constructed and were applied to the different economic sectors, is in the form of a dynamic computerised water entitlement model which can be used to identify and quantify the following indicators:

- Macro - Economic benefits.
- Maximum possible water reduction.
- Capitalised impact.

The approach to calculate the macro-economy indicators of each of the Economic Regions in the project area was to identify and establish the detailed water users in terms of volume used. The main inputs required for the irrigation agriculture and forestry model is the water volumes and number of hectares. Dry land sugar cane production was not included although two of the sugar mills do mill large quantities of rain fed cane production and are large water users and the primary production feed into the secondary production sector.

The output of the model provides direct, indirect and induced results for all the identified economic sectors. For agriculture the model can accommodate up to twenty different products and for forestry it provides for pine, gum and wattle sub-species. An example of the direct, indirect and induced effects explained by means of the agricultural sector is:

- Direct effect: Refers to effects occurring directly in the agriculture sector such as the hectares cultivated impacts.
- Indirect effects: Refer to those effects occurring in the different economic sectors that link backward to agriculture due to the supply of intermediate inputs, i.e. fertilisers, seeds, etc.
- Induced effects: Refers to the chain reaction triggered by the salaries and profits (less retained earnings) that are ploughed back into the economy in the form of private consumption expenditure.

The following parameters are used to determine the impacts estimated by the model:

- GDP.
- Payments to Households, with a particular focus on the low income households and total households.
- Employment creation.

Direct employment and payment to low income households are the two macro-economic parameters providing an indication of the socio–economic contribution of the natural resource to the local community.

2.2 Determination of the annual turnover of the different economic sectors

Different approaches were used to arrive at projected annual turnover per economic sector as explained in the following paragraphs.

2.2.1 Assessment of the turnover of irrigation agriculture

The crops were identified and the actual hectares irrigated established. The expected yield per hectare was multiplied with the average price per ton to determine the estimated annual hectare turnover. This was then multiplied with the number of hectares.

Average turnover per hectare = crop yield (ton/ha) x price (Rand/ha)

Economic zone turnover = Average turnover (Rand/ha) x Number of hectares in production

Changes in yields per area were taken into consideration. Sugar cane production gradually decreases from the Pongola River system down to Mhlathuze as the heat unit's decrease[1].

2.2.2 Afforestation

The same approach was followed as in the case of irrigation crops. As the annual growth per tree type varies from the higher lying areas to the coastal areas of Zululand the average yield per hectare[2] were adapted.

The area estimation per tree type was based on the Department of Agriculture publication: - "*Report on Commercial Timber Resources and Primary Roundwood Processing in South Africa"*. This was supported by work done by Conningarth Economists[3] for a study on the Usuthu, Pongola and Maputo Rivers.

2.2.3 Sugar Mills

The annual throughput per mill is available from the South African Sugar Association and an estimation of the annual turnover was based on this tonnage multiplied with the price per ton provided by the Sugar Association.

2.2.4 Saw Mills, Pulp and Wood Chip Facilities

Raw wood from felled plantations can head in at least six different directions, namely:

- Saw mills;
- Pulp mills;
- Wood Chip Facilities;
- Poles,
- Wattle bark facilities, and
- Charcoal and firewood.

A complicating issue is that the distribution to the different processing facilities changes from region to region. Also, the pulp and wood chip facilities are concentrated at Richards Bay and facilities just north

[1] South African Cane Growers
[2] Source: Forestry Economic Services.
[3] Source: Aurecon – Progressive Realisation of the Inco Maputo Agreement.

of the Tugela River. Saw mills are located in the production areas but wood is also transported from catchment to catchment.

The Genesis Analytics (Pty) Ltd Report: The Contribution, Costs and Development Opportunities of Forestry, Timber, Pulp and Paper Industries in South Africa 2005 were used as the base reference document. The use of the document made it possible to develop multipliers that could be used with 2012 prices to calculate the annual turnovers and employment per catchment.

2.2.5 Heavy Industry- Lower Mhlatuze

The values are based on original work done by Conningarth Economists during 2010 – 2011 on water licensing in the catchment area, this includes the Richards Bay Minerals dune mining.

2.2.6 Mining

A detailed survey of all the mines was done per catchment using the Department of Mineral Resources' available data and published production tonnes by the different mining companies. In the case of coal mines actual product produced is available and by multiplying it with the average price a value could be determined. With other products the tons ore was available and the mineral extraction was determined on average yield and the annual turnover was then established.

There has been a substantial decline in coal mining in KwaZulu-Natal over recent years, with the closing of major collieries. The KwaZulu-Natal coalfields are the major producers of high quality anthracite in the country. Some collieries in the Vryheid Coalfield produce coking coal. The coalfields are still set to remain the country's major source of anthracite, bituminous and high quality metallurgical coal for local industry. The main coal users in the area are the pulp, paper and textile industry.

The close proximity to South Africa's shipping facilities at Richard's Bay and Durban is an advantage for the KwaZulu-Natal coal producers since the rail and road transport distances are relatively short compared to other coalfields in the country. This makes the export market and its associated international rand hedge prices very attractive. Prospecting and New Order Mining Right applications are still submitted to the Department of Mineral Resources (Department of Minerals and Energy) for both new and reworking of closed mines.

2.2.7 Tourism

A detailed internet search was done to determine the number of beds available per catchment as well as the average applicable rates. This had to be done as the local authority tourism desk in the project areas could not provide any data on the number of beds available. A number of establishments in the different catchment areas were contacted in order to establish an average occupation rate. All this data was then computerised to determine an estimated number of bed nights per annum per catchment.

Using the number of bed nights together with the Statistic SA[4] 2012 domestic spending ratio a total annual spending per catchment was established.

2.3 Approach to the valuation of ecosystem goods and services from the environmental flows

The assessment of the socio-economic profile of the Usutu to Mhlathuze Catchments followed an accepted approach which is demonstrated in **Figure 2.1** below. The assessment can be conducted at three approaches depending on the type of the scale and extent of each socio-economic zone namely the partial, total and impact assessment.

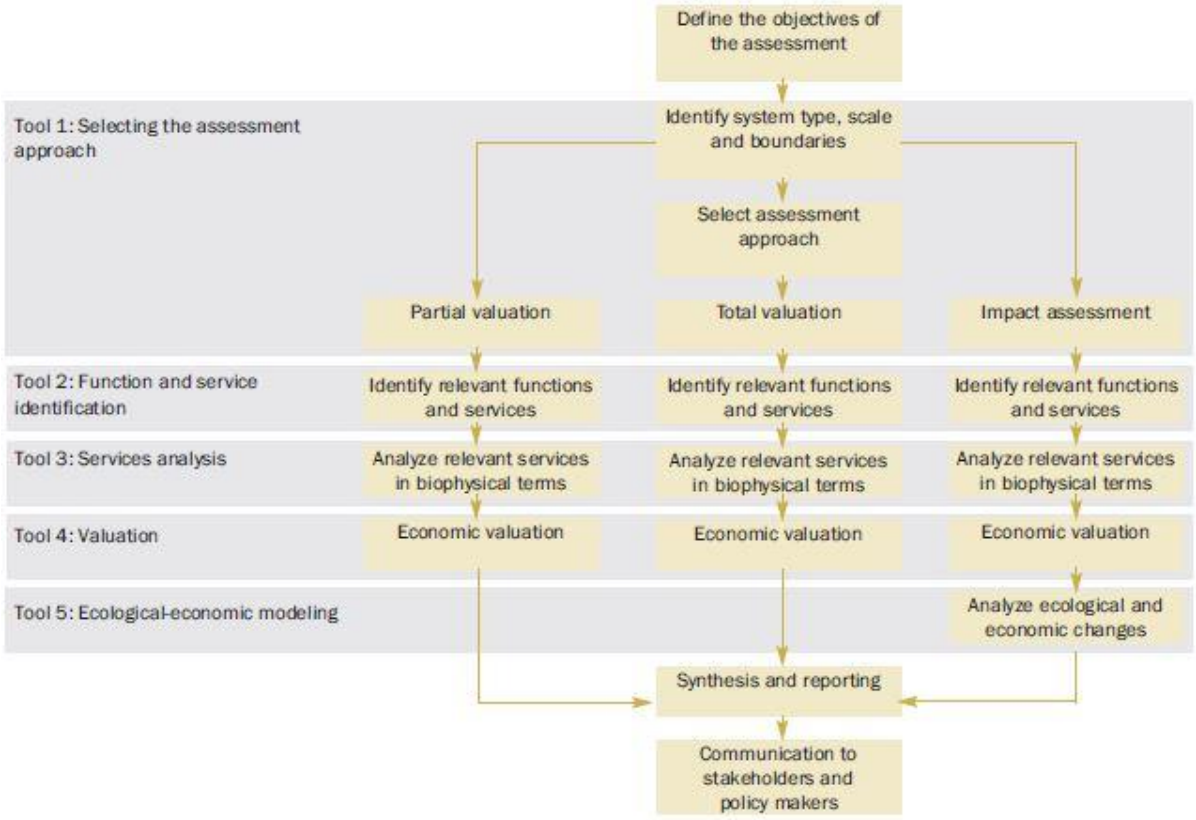


Figure 2:1: Process followed in the assessment of the socio-economy of Usutu Mhlathuze catchments

The focus of the impact assessment of the economic activities in the Usutu- Mhlathuze catchments has been on the total valuation of the economic activities and ecosystem goods and services with a view to ensure a balance between the need to sustain the formal activities for the wellbeing of the communities while maintaining the ecosystem functioning of Usutu to Mhlathuze systems which also important for the social wellbeing of the communities particularly the vulnerable sectors of the community. This approach is useful where the main input factor of production, which is the water resource is limited. It is appropriate where a full accounting of the benefits provided by an area under

[4] Statistics SA: - Statistical Release P0352.1- Domestic Tourism Survey 2012.

a certain management system is required. Impact Assessment is required to understand the changes in the ecosystem, and to subsequently analyse the economic benefits of the new management regime

3 MACRO-ECONOMIC PROFILE OF THE USUTU – MHLATUZE CATCHMENTS

3.1 General

The main economic activities which are dependent on the water resources of the Usutu to Mhlathuze River catchments were identified and the value of water to sustain these activities determined. per individual catchment were identified and the data per economic sector was identified. The study is concerned with the establishment of the economic baseline in order to eventually be able to measure the deviation from the baseline. For possible changes in water allocation certain groupings were necessary in attaining the resulting baseline. The following economic sectors were considered in the assessment of the current economic value of the sectors:

- *Irrigation agriculture* –The irrigation crops were grouped as grain crops representing the maize production which is dependent on irrigation, cabbages representing the winter vegetable group and cucurbits the summer vegetable group. Bananas and citrus were kept separate together with cotton. Sugar cane production was kept separate as the mills play a very important beneficiation role.
- *Commercial forestry* –Commercial forestry is a major streamflow reduction activity which has a major impact on the ecosystem functioning in the Usutu – Mhlathuze catchment. The commercial forestry activities were divided into gum, pine and wattle. There are also saw mills which have been kept as part of the commercial forestry.
- *Mining* – Although there are no major mining activities in the catchments, as much as possible information was incorporated. The main mining activities identified were coal mining and the heavy metals produced from the sand mining areas along the coastal dunes.
- *Sugar mills* – Sugar cane in the Usutu-Mhlathuze is dependent on rainfall and not irrigate. As a result it has a major impact on the environmental flows required to sustainable ecosystem functions of the water resource systems. Besides the primary activity of sugar cane agriculture, there are the secondary industries which comprise of the sugar mills.
- *Saw mills* – The direct downstream industries of commercial forestry include timber industries and saw mills. This has been kept separate.
- The heavy industry in the lower Mhlatuze was treated as a unit. This is also the only catchment were light industry was incorporated as a number of them are using more than normal water.

3.2 Economic zones of the Usutu – Mhlathuze Catchments

Thirteen economic zones were identified for the Usutu – Mhlathuze catchments (see **Figure 4.1** below) as follows:

Figure 3:1: Map of the economic activities in the Usutu to Mhlathuze catchments

(i). The Mkhondo / Assegai economic zone which is situated in the Assegai River, a tributary of the Usuthu above the Swaziland border, with the Heyshope Dam as the major water resource in the catchment. Piet Retief is the main business centre. The main economic activities are commercial forestry, saw mills and irrigation agriculture. Some mining activities are also currently operational and numerous mine prospecting are taking place.

(ii). The Upper Pongola economic zone which stretches from the headwaters in Paulpietersburg area to the Pongolapoort Dam. The major economic activities include coal mining and commercial forestry in the upper catchments, irrigation agriculture in the lower catchment and eco-tourism. Significant water is therefore abstracted from the Pongola River system for irrigation agriculture. The major stabilising dam as far as available irrigation water is concerned is the Bivaan Dam. Water from the Pongolapoort dam is transferred to the Mkhuze River catchment for irrigation purposes.

(iii). The Lower Pongola economic zone covers the area below the Pongolapoort Dam, along the Pongola River, to the Mozambique border. This zone is characterised by the Makatini Flats and the floodplains and pans in the Pongola Flood plains. Irrigation agriculture and eco – tourism is the main economic activities.

(iv). The Kosi Bay / Sodwana economic zone includes the area along the east coast from Kosi Bay to Sodwana Bay National Park. The Kosi Bay and Lake Sibayi system has significant wetlands. The main economic activities are eco – tourism and commercial forestry.

(v). The Mkhuze River economic zone – this area is mainly driven by the run-of-river irrigation of sugar cane and water transferred from the Pongolapoort Dam and Macadamia nuts from the Mkhuze irrigation scheme. There is significant eco-tourism in the lower catchments which includes the Mkhuze Game Reserve.

(vi). The Hluhluwe River economic zone covers the area west of the N2 north and includes the Hluhluwe Dam and the northern part of the Mfolozi Game Reserve and the False Bay section of St Lucia as eco-tourist attractions. The main economic activities are irrigation agriculture and tourism. The area produces about 90% of the national Queen pineapples destined for the fresh produce markets and export.

(vii). The St. Lucia economic zone includes the west bank of Lake St. Lucia, the St. Lucia Estuary and north along the St. Lucia Marine Reserve and the northern area of the Lake to the Mkhuze River. Some commercial forestry still occurs, but the main economic activity is eco – tourism as the area is also classified as a World Heritage Site.

(viii). The Black Mfolozi River economic zone – the economic activities in this zone are restricted to commercial forestry and irrigation activities dependent on the run-of-river abstraction with significant abstractions planned in the near future to meet the domestic water requirements.

(ix). The White Mfolozi River economic zone – this is driven by commercial forestry, irrigation agriculture and commercial developments in Vryheid, Ulundi and Nongoma in particular. The Klipfontein Dam is the main source of water for the White Mfolozi River.

(x). The Lower Mfolozi River – Mfolozi nature reserve including agriculture and tourism, Lake St Lucia provides economic activities for the area. The Mtubatuba sugar mill is in the area as well as some sand dune mining activities.

(xi). The Upper Mhlathuze River economic zone – this extends from the headwaters of the Mhlathuze to Heatonville and Nkwaleni irrigation schemes below the Goedertrouw Dam. Considerable commercial forestry occurs in the upper sections of the catchment. The main irrigation crops are sugar cane, citrus (grapefruit) and banana supplemented by winter vegetables.

(xii). The Lower Mhlathuze River economic zone – driven by the Richards Bay industrial complex with major industries dependent on the Mhlathuze River. The industries are dependent on releases from the Goedertrouw Dam and the water is distributed by the Mhlathuze Water Board.

(xiii). The Matigule / Mhlazi economic zone – this is an unregulated system with commercial forestry the main economic activity as well as tourism along the coast.

3.3 Identification of economic activities and water use in each economic zone

3.3.1 Mkhondo / Assegai economic zone

3.3.1.1 Commercial Forestry Sector

The commercial forestry sector in this economic zone includes gum, pine and wattle with gum covering a very large area, approximately 239 322 hectares. There are a number of beneficiation plants in the district depending on the production of wood, saw mills and pole treating units.

Table 3.1: Mkhondo / Assegai – Commercial Forestry

Parameters	Gum	Pine	Wattle
Forestry Hectares	166 878	55 565	16 879
Production (Tons/ha/annum)	11.49	15.19	9.84
Production (Gross Income Rand/ha)	7 469	8 886	9 714
Direct Employment/ha	0.05	0.05	0.05
Estimated Water Usage (m^3/ha)	946	769	738

3.3.1.2 Commercial Agriculture Sector

The main field crop in the Mkhondo Assegai catchment is maize with some winter vegetables. There is approximately 3 026 hectares of maize under irrigation.

Table 3.2: Mkhondo / Assegai – Commercial Agriculture

Parameters	Maize	Vegetables (Winter)
Crop Hectares	3 026	469
Production (Tons/ha)	12	80
Annual Production (Gross Income Rand/ha)	25 800	102 400
Direct Employment/ha	0.06	1.35
Estimated Water Usage (m^3/ha)	3 800	1 760

3.3.1.3 Mining, saw mills and eco-tourism

The industry sector includes saw mills, mining and eco-tourism. The Yellowstone Timbers and Busby Saw mills and an underground coal mine near Piet Retief are operating in the economic zone. Tourism in the sector includes both business and eco-tourists. The major water user is the saw mills which used water for cooling.

Table 3.3: Mkhondo / Assegai – Industry

Parameters	Saw Mills	Mining	Eco-Tourism
Annual Turnover (Rand million)	1 070	1 492	103
Direct Employment	4 776	1 680	480
Current water usage [Mm^3]	1.3	0.057	0.046
Eco-Tourism			
* *Estimated Number of Bed Nights Sold*	n/a	n/a	114 945
* *Spending per Tourist (Rand/day)*	n/a	n/a	894.31
* Water per tourist (m^3/day)	n/a	n/a	0.40

3.3.2 Upper Pongola economic zone

The major economic activities in the Upper Pongola River catchments include coal and gold mining, commercial forestry and irrigation agriculture (from Impala Irrigation Scheme) in the lower catchment and eco-tourism at the Ithala Nature Reserve and around the Pongolapoort Dam.

3.3.2.1 Commercial Forestry

As illustrated in **Table 3.4 below**, the Commercial Forestry Sector comprises all three timber tree species with some smaller saw mills in the area comprising about 107 127 hectares. Some of the logs are transported to the Piet Retief area to the larger saw mills.

Table 3.4: Upper Pongola – Commercial Forestry

Parameters	Gum	Pine	Wattle
Forestry Hectares	74 699	24 873	7 555
Production (Tons/ha)	11.49	15.19	9.84
Production (Gross Income)	7 469	8 886	9 714
Direct Employment/ha	0.05	0.05	0.05
Estimated Water Usage (m^3/ha)	753	646	694

3.3.2.2 Commercial Irrigation Agriculture

The Impala Irrigation Board is situated in the Upper Pongola River catchment and diverts approximately 170.01 million m^3/a for irrigation of mainly sugar cane production. Other crops consist of maize and summer vegetable crops in the high lying areas with the very large sugar cane production area around Pongola.

Table 3.5: Upper Pongola – Commercial Agriculture

Parameters	Maize	Vegetables (Summer)	Irrigated Sugar Cane
Crop Hectares	1 673	793	17 107
Production (Tons/ha)	12	22	80
Annual Production (Gross Income Rand/ha)	25 800	42 350	30 778
Direct Employment/ha	0.06	0.80	0.16
Estimated Water Usage (m^3/ha)	4 150	2 050	10 000

3.3.2.3 Industry Sector

Some small coal and gold mining is taking place in the upper reaches. The Transvaal Sugar Board (TSB) Sugar Mill in Pongola is an important beneficiation unit in the economic zone and contributes significantly to the economy of the

Table 3.6: Upper Pongola – Industry

Parameters	Saw Mills	Mining	Sugar Mills	Eco-Tourism
Turnover	479	74	899	370
Direct Employment	2 138	85	450	1 729
Current water usage [Mm^3]	0.58	0.290	2	0.074
Eco-Tourism				
** Estimated Number of Bed Nights Sold*	*n/a*	*n/a*	*n/a*	*185 707*
** Spending per Tourist (Rand/day)*	*n/a*	*n/a*	*n/a*	*1 993*
** Water per tourist (m^3/day)*	*n/a*	*n/a*	*n/a*	*0.40*

3.3.3 Lower Pongola economic zone

3.3.3.1 Eco-tourism

The major economic activity in the lower Pongola River catchments is eco-tourism which includes the recreational facilities of the Pongolapoort Dam and the Nduma Game Reserve with perlite and zeolite mining present in the area.

3.3.3.2 Commercial Agriculture

Over many years various initiatives was started to develop the irrigation area to its full potential. One of the more successful ventures was cotton production the cotton gin was liquidated and according to Cotton SA no cotton is currently produced in the region.

The hectares mentioned in the table below is based on aerial photographs measurements and only the sugar cane production area could be semi verified.

Table 3.7: Lower Pongola – Commercial Agriculture

Parameters	Maize	Vegetables (Winter)	Irrigated Sugar Cane
Crop Hectares	3 849	2 939	6 675
Production (Tons/ha)	12	80	80
Annual Production (Gross Income)	25 800	102 400	30 778
Direct Employment/ha	0.06	1.35	0.16
Estimated Water Usage (m^3/ha)	5 450	2 960	16 270

3.3.3.3 Industry Sector

The only industry in the area is the Pratley Nxwala Mine, north of Ubombo, mining perlite and zeolite.

Table 3.8: Lower Pongola – Industry

Parameter	Saw Mills	Mining	Sugar Mills	Light Industry	Eco-Tourism
Turnover	-	58.50	-	-	143
Direct Employment	-	88	-	-	668
Current water usage [Mm^3]	-	0.01	-	-	0.031
Eco-Tourism					
** Estimated Number of Beds Sold*	*n/a*	*n/a*	*n/a*	*n/a*	*78 606*
** Spending per Tourist (Rand/day)*	*n/a*	*n/a*	*n/a*	*n/a*	*1 819.77*
** Water per tourist (m^3/day)*	*n/a*	*n/a*	*n/a*	*n/a*	*0.4000*

3.3.4 Kosi Bay / Sodwana economic zone

The main economic activities in the Kosi Bay and Sodwane economic zone include commercial forestry which is a streamflow reduction activity and eco-tourism. The economic activities are

depended on groundwater, wetlands and lakes which are fed mainly by groundwater. There is very limited surface water.

3.3.4.1 Commercial Forestry Sector

The Commercial Forestry Sector comprises just over 17 000 hectares with no wattle plantations.

Table 3.9: Kosi Bay / Sodwana – Commercial Forestry

Parameters	Gum	Pine
Forestry Hectares	7 422	9 602
Production (Tons/ha/a)	25	15
Production (Gross Income Rand/ha)	16 263	8 488
Direct Employment/ha	0.06	0.06
Estimated Water Usage (m^3/ha)	775	615

3.3.4.2 Industry and tourism

The tourism sites include the Tembe Elephant Park, the Kosi Bay Nature Reserve, Maputuland Marine Reserve, and Sodwana Bay National Park with the unspoilt coastline and reefs at Sodwana are important attractions to sea fishermen (marlin and big game angling with fully equipped boats) and scuba diving at Sodwana are the main eco-tourism attractions.

A relative small sawmill is operating in the area, the saw mill data estimated in the table is based on the total production and not the estimated turnover of the saw mill. The tourism sector is growing constantly and tariffs are relatively high. The tourism destinations include the Tembe Elephant Park, the Kosi Bay Nature Reserve, Maputuland Marine Reserve and Sodwana Bay National Park with the unspoilt coastline and reefs at Sodwana are important attractions to sea fishermen (marlin and big game angling with fully equipped boats) and scuba diving at Sodwana are the main eco-tourism attractions.

Table 3.10: Kosi Bay / Sodwana – Industry

Parameters	Saw Mills	Eco-Tourism
Turnover (R Million)	119	472
Direct Employment	530	2 206
Current water usage [Mm^3]	0.144	0.138
Eco-Tourism		
** Estimated Number of Beds Sold*	*n/a*	*344 506*
** Spending per Tourist (Rand/day)*	*n/a*	*1 370*
** Water per tourist (m^3/day)*	*n/a*	*0.40*

3.3.5 Mkhuze economic zone

There is commercial forestry, irrigation agriculture in the Mkhuze Irrigation Scheme area and some industries identified in the Mkhuze River catchment. In addition irrigation water is transferred from the Pongolapoort Dam of approximately 30 million m^3/a. Some of the water transfer is for domestic water use.

3.3.5.1 Commercial Forestry Sector

The Commercial Forestry Sector comprises around 40 000 hectares of gum, pine and wattle trees.

Table 3.11: Mkhuze – Commercial Forestry

Parameters	Gum	Pine	Wattle
Forestry Hectares	27 292	9 087	2 760
Production (Tons/ha)	11.49	15.19	9.84
Production (Gross Income)	7 469	8 886	9 714
Direct Employment/ha	0.05	0.05	0.05
Estimated Water Usage (m^3/ha)	595	478	475

3.3.5.2 Commercial Agriculture Sector

The irrigation section of the Commercial Agriculture Sector comprises of over 5 000 hectares of sugar cane which is irrigated with water transferred from the Pongola catchment. The rest of the irrigation is either from ground water sources or run of the river.

Irrigated sugar cane is the main crop cultivated with vegetables (winter), citrus (grape fruit) and maize.

Table 3.12: Mkhuze – Commercial Agriculture

Parameters	Maize	Vegetables (Winter)	Citrus Grape Fruit	Irrigated Sugar Cane
Crop Hectares	222	941	222	5 128
Production (Tons/ha)	12	80	41	80
Annual Production (Gross Income)	25 800	102 400	104 909	30 778
Direct Employment/ha	0.06	1.35	1.38	0.16
Estimated Water Usage (m^3/ha)	4 640	2 750	12 600	12 700

3.3.5.3 Industry Sector

Saw mills are operating in the area, but the sugar cane is transported down to the mill at Mtubatuba. The Mkhuze conservation park is in the lower reaches of the area, before the river enters St Lucia.

The area remains a popular eco-tourist attraction.

Table 3.13: Mkhuze – Industry

Parameters	Saw Mills	Eco-Tourism
Turnover (R Million)	175	261
Direct Employment	781	1 218
Current water usage [Mm^3]	0.21	0.0335
Eco-Tourism		
** Estimated Number of Bed Nights Sold*	*n/a*	*83 789*
** Spending per Tourist (Rand/day)*	*n/a*	*3 111*
** Water per tourist (m^3/day)*	*n/a*	*0.40*

3.3.6 Hluhluwe River economic zone

The Hluhluwe River catchment is known for its pineapples downstream of Hluhluwe Dam and some commercial forestry. These are discussed below.

3.3.6.1 Commercial Forestry Sector

A relatively small commercial forestry sector occurs in the zone, with 13 000 hectares of gum and pine plantations is being cultivated.

Table 3.14: Hluhluwe River – Commercial Forestry

Parameters	Gum	Pine
Forestry Hectares	5 814	7 521
Production (Tons/ha)	25	15
Production (Gross Income)	16 263	8 488
Direct Employment/ha	0.06	0.06
Estimated Water Usage (m^3/ha)	562	385

3.3.6.2 Commercial Agriculture Sector

The area primarily produces sugar cane, pineapples and cotton. The irrigated sugar cane is an important water user in the sector.

The commercial agriculture activities produce about 90% of the RSA Queen pineapples, mostly sold on the Gauteng markets or exported. The research station is of the opinion that very little if any pineapple area is irrigated, some farmers mention relatively small areas, finally it settled at 40 hectares irrigated. According to Cotton South Africa about 200 hectares is under production below the Hluhluwe Dam.

Table 3.15: Hluhluwe River – Commercial Agriculture

Parameters	Pineapples	Irrigated Sugar Cane	Cotton
Crop Hectares	44	1 888	202
Production (Tons/ha)	40	90	3.1
Annual Production (Gross Income)	200 508	34 625	18 600
Direct Employment/ha	0.89	0.17	0.17
Estimated Water Usage (m^3/ha)	4 000	12 700	5 210

3.3.6.3 Industry Sector

The sugar cane produced in the area is transported to the Mtubatuba sugar mill. The saw mill is relatively small and it appears as if some of the wood produced is transported saw mills outside of this economic zone. The tourism sector is growing and a number of new establishments are planned. The main tourism attractions in the area are the Hluhluwe Game Reserve and the northern section of the Hluhluwe / Umfolozi Game Reserve.

Table 3.16: Hluhluwe River – Industry

Parameters	Saw Mills	Eco-Tourism
Turnover (R Million)	93	667
Direct Employment	415	3 117
Current water usage [Mm^3]	0.11	0.1449
Eco-Tourism		
** Estimated Number of Beds Nights Sold*	*n/a*	*362 369*
** Spending per Tourist (Rand/day)*	*n/a*	*1 841*
** Water per tourist (m^3/day)*	*n/a*	*0.40*

3.3.7 St. Lucia economic zone

St Lucia economic zone is part of a world heritage site and over a number of years a concerted effort has been made to reduce the area of commercial forestry and simultaneously expanding the nature reserve area, with a focus on eco-tourism is the major economic activity. This has a limited impact on the ecosystem function of St Lucia and surrounding areas.

3.3.7.1 Commercial Forestry Sector

The remaining commercial forestry area is around 12 100 hectares.

Table 3.17: St. Lucia – Commercial Forestry

Parameters	Gum	Pine
Forestry Hectares	5 274	6 822
Production (Tons/ha)	25	15
Production (Gross Income)	16 263	8 488
Direct Employment/ha	0.06	0.06
Estimated Water Usage (m^3/ha)	775	615

3.3.7.2 Commercial Agriculture Sector

As far as it was possible to collect relevant information regarding commercial agriculture activities, no information of such activities could be found in the economic zone; however, some traditional farming is practised.

3.3.7.3 Industry Sector

This area is a popular holiday resort and includes eco-tourists for the phenomenal diversity of tropical fish, large schools of pelagic fish, turtles and whale sharks as well as the large numbers of crocodile and hippo in the lake area. The nature conservation park is now claiming to have the big five on show. According to our estimate the sector employs over 9 000 people in the hospitality industry.

Table 3.18: St. Lucia – Industry

Parameters	Saw Mills	Eco-Tourism
Turnover (R Million)	84	2 029
Direct Employment	377	9 482
Current water usage [Mm^3]	0.10	0.327
Eco-Tourism		
* Estimated Number of Beds Nights Sold	n/a	816 505
* Spending per Tourist (Rand/day)	n/a	2 486
* Water per tourist (m^3/day)	n/a	0.40

3.3.8 Black Mfolozi economic zone

3.3.8.1 Commercial Forestry Sector

The Commercial Forestry Sector represents approximately 14 000 hectares of gum, pine and wattle plantations.

Table 3.19: Black Mfolozi – Commercial Forestry

Parameters	Gum	Pine	Wattle
Forestry Hectares	9 832	3 274	994
Production (Tons/ha)	11.49	15.19	9.84
Production (Gross Income)	7 469	8 886	9 714
Direct Employment/ha	0.05	0.05	0.05
Estimated Water Usage (m^3/ha)	1 057	794	750

Commercial Agriculture Sector

The crops under irrigation in this sector consists of maize and both summer and winter vegetable crops.

Table 3.20: Black Mfolozi – Commercial Agriculture

Parameters	Maize	Vegetables (Summer)	Vegetables (Winter)
Crop Hectares	1 748	1 088	1 049
Production (Tons/ha)	12	22	80
Annual Production (Gross Income)	25 800	42 350	102 400
Direct Employment/ha	0.06	0.80	1.35
Estimated Water Usage (m^3/ha)	4 640	2 750	2 750

3.3.8.2 Industry Sector

Coal and anthracite mining is also present in the area and there are plans afoot to expand by opening new mines. The area has eco-tourism mainly consists of scenic drives and visits to historic and cultural places.

Table 3.21: Black Mfolozi – Industry

Parameters	Saw Mills	Mining	Eco-Tourism
Turnover (R Million)	111	1 243	37
Direct Employment	495	2 881	175
Current water usage [Mm^3]	0.13	0.375	0.0039
Eco-Tourism			
** Estimated Number of Bed Nights Sold*	n/a	n/a	9 643
** Spending per Tourist (Rand/day)*	n/a	n/a	3 887
** Water per tourist (m^3/day)*	n/a	n/a	0.40

3.3.9 White Mfolozi economic zone

3.3.9.1 Commercial Forestry Sector

The Commercial Forestry Sector comprises of approximately 33 500 hectares with all three of the major tree species present.

Table 3.22: White Mfolozi – Commercial Forestry

Parameters	Gum	Pine	Wattle
Forestry Hectares	23 178	7 718	2 344
Production (Tons/ha)	11.49	15.19	9.84
Production (Gross Income)	7 469	8 886	9 714
Direct Employment/ha	0.05	0.05	0.05
Estimated Water Usage (m^3/ha)	1 041	820	866

3.3.9.2 Commercial Agriculture Sector

The irrigation sector is small with only maize being produced in relatively large quantities.

Table 3.23: White Mfolozi – Commercial Agriculture

Parameters	Maize
Crop Hectares	449
Production (Tons/ha)	12
Annual Production (Gross Income)	25 800
Direct Employment/ha	0.06
Estimated Water Usage (m^3/ha)	4 640

3.3.9.3 Industry Sector

Saw milling activities and coal mining activities are present in the zone with a growing tourism sector. Tourism includes historical battle fields, southern area of the Umfolozi Game Reserve and scenic routes.

Table 3.24: White Mfolozi – Industry

Parameters	Saw Mills	Mining	Eco-Tourism
Turnover (R Million)	261	670	101
Direct Employment	1 166	1 540	470
Current water usage [Mm^3]	0.32	0.037	0.0284
Eco-Tourism			
** Estimated Number of Bed Nights Sold*	*n/a*	*n/a*	*71 035*
** Spending per Tourist (Rand/day)*	*n/a*	*n/a*	*1 417*
** Water per tourist (m^3/day)*	*n/a*	*n/a*	*0.40*

3.3.10 Mfolozi economic zone

3.3.10.1 Commercial Forestry Sector

The Commercial Forestry Sector is on the coastal flat area and only gum and pine plantations are present, the total estimated area are about 23 000 hectares.

Table 3.25: Lower Mfolozi – Commercial Forestry

Parameters	Gum	Pine
Forestry Hectares	9 996	12 933
Production (Tons/ha)	25	15
Production (Gross Income)	16 263	8 488
Direct Employment/ha	0.06	0.06
Estimated Water Usage (m^3/ha)	775	615

3.3.10.2 Commercial Agriculture Sector

The irrigation section of the Commercial Agriculture Sector is for all practical purposes directed at sugar cane production.

Table 3.26: Lower Mfolozi – Commercial Agriculture

Parameters	Irrigated Sugar Cane
Crop Hectares	10 712
Production (Tons/ha)	75
Annual Production (Gross Income)	28 855
Direct Employment/ha	0.15
Estimated Water Usage (m^3/ha)	10 600

3.3.10.3 Industry Sector

The Umfolozi Sugar Mill is located in the economic zone with a number of saw mills and part of the expanding Richards Bay Mineral mining overlaps into the zone. We could not determine the northern perimeter of the present dune mining.

The Lower Mfolozi is a popular holiday destination.

Table 3.27: Lower Mfolozi – Industry

Parameters	Saw Mills	Mining	Sugar Mills	Eco-Tourism
Turnover (R Million)	160	1 874	636	126
Direct Employment	714	2 159	450	588
Current water usage [Mm^3]	0.19	0.399	2.00	0.046
Eco-Tourism				
** Estimated Number of Bed Nights Sold*	*n/a*	*n/a*	*n/a*	*115 705*
** Spending per Tourist (Rand/day)*	*n/a*	*n/a*	*n/a*	*1 089*
** Water per tourist (m^3/day)*	*n/a*	*n/a*	*n/a*	*0.40*

3.3.11 Upper Mhlathuze economic zone

3.3.11.1 Commercial Forestry Sector

The total commercial forestry area is in the head waters of the Mhlathuze catchment. Currently most of the plantations are under the control of large commercial companies such as SAPPI and Mondi. These are supplemented by a number of small growers with small woodlots. Most of the wood is either delivered to the Mondi factory at Richards Bay or exported. The total plantation area is approximately 42 000 ha.

Table 3.28: Upper Mhlathuze – Commercial Forestry

Parameters	Gum	Pine	Wattle
Forestry Hectares	29 143	9 704	2 948
Production (Tons/ha)	11	15	10
Production (Gross Income)	7 469	8 886	9 714
Direct Employment/ha	0.05	0.05	0.05
Estimated Water Usage (m^3/ha)	1 036	714	747

3.3.11.2 Commercial Agriculture Sector

Two major irrigation areas occur in the zone, namely the Heatonville and Nkwaleni irrigation areas, both using water from the Goedertrouw Dam. In the case of the Heatonville irrigation mostly sugar cane is produced. In the case of Nkwaleni irrigation a large area, nearly 3 000 hectares are under citrus production, mostly grapefruit for the export market. A wide variety of vegetables for the local market are also produced. The sugar cane is delivered to the mill at Felixton.

Table 3.29: Upper Mhlathuze – Commercial Agriculture

Parameters	**Vegetables (Summer)**	**Vegetables (Winter)**	**Citrus Grape Fruit**	**Irrigated Sugar Cane**
Crop Hectares	68	126	2 968	12 964
Production (Tons/ha)	22	80	41	70
Annual Production (Gross Income)	42 350	102 400	104 909	26 931
Direct Employment/ha	0.80	1.35	1.38	0.15
Estimated Water Usage (m^3/ha)	1 500	1 470	8 220	12 700

3.3.11.3 Industry Sector

A number of saw mills are operating in the economic zone but most of the wood is delivered to chipping and pulp facilities in Richards Bay.

Table 3.30: Upper Mhlathuze – Industry

Parameters	**Saw Mills**	**Eco-Tourism**
Turnover (R Million)	187	245
Direct Employment	834	1 144
Current water usage [Mm^3]	0.23	0.093
Eco-Tourism		
** Estimated Number of Bed Nights Sold*	*n/a*	*232 505*
** Spending per Tourist (Rand/day)*	*n/a*	*1 053*
** Water per tourist (m^3/day)*	*n/a*	*0.40*

3.3.12 Lower Mhlathuze economic zone

3.3.12.1 Commercial Forestry Sector

The Commercial Forestry Sector occurs to the North of Richards bay on the coastal plain and is approximately 22 700 hectares in extend.

Table 3.31: Lower Mhlathuze – Commercial Forestry

Parameters	Gum	Pine
Forestry Hectares	9 480	12 265
Production (Tons/ha)	25	15
Production (Gross Income)	16 263	8 488
Direct Employment/ha	0.06	0.06
Estimated Water Usage (m^3/ha)	1 087	840

3.3.12.2 Commercial Agriculture Sector

A wide variety of crops are produced from winter and summer vegetables, bananas and grapefruit and sugar cane. The citrus is mostly exported and vegetables and bananas sold on the local market. The sugar cane is delivered to the mill at Felixton.

Table 3.32: Lower Mhlathuze – Commercial Agriculture

Parameters	Vegetables (Summer)	Vegetables (Winter)	Bananas	Citrus Grape Fruit	Irrigated Sugar Cane
Crop Hectares	91	168	97	72	1 379
Production (Tons/ha)	22	80	41	41	70
Annual Production (Gross Income)	42 350	102 400	136 080	104 909	34 625
Direct Employment/ha	0.80	1.35	1.06	1.38	0.17
Estimated Water Usage (m^3/ha)	2 100	1 250	8 770	6 810	9 930

3.3.12.3 Industry Sector

The Lower Mhlatuze represents one of the large industrial areas of not only KwaZulu-Natal but also South Africa. At Felixton there is a pulp mill and the largest sugar mill in South Africa. In Richards Bay is found the Aluminium smelters, Bayside and Hillside smelters, fertilizer factory, another pulp mill and wood chip unit and the very large coal terminal. This is all supplemented the Richards Bay mineral sand dune mining operation.

A number of light industry units are also operating in the area consuming a larger volume of water.

From the establishment of the original core industries at Richards Bay / Empangeni there followed many secondary industries and service related activities, contributing to a growing industrial area. Although the availability of a harbour and other infrastructure linking the port to the rest of South Africa and Africa is very important, the availability of water from the Mhlathuze River plays a crucial role in the economic future of the basin. The availability of water will determine the future industrial growth of the region.

Mondi Felixton - Pulp Mill and Tongaat Hulett Felixton - Sugar Mill. Bayside and Hillside Aluminium (formally Allusive) - Aluminium Smelter, Indian Ocean Fertilizer - Fertilizer factory, Richards Bay Iron Titanium Works, Richards Bay Minerals – Smelter, Mondi Richards Bay - Pulp Mill and the Richards Bay Coal Terminal. Dune mining and other mining is present in the area. Ticor (Felixton) has proposed mining of the area south of Mtunzini by Ticor SA (Pty) Ltd.

Table 3.33: Lower Mhlathuze – Industry

Parameters	Saw Mills	Heavy Industry and Mining	Sugar Mills	Light Industry	Eco-Tourism
Turnover (R Million)	152	66 744	906	6 720	480
Direct Employment	677	11 392	450	11 449	2 243
Current water usage [Mm^3]	0.18	94.87	2.00	3.33	0.098
Eco-Tourism					
** Estimated Number of Bed Nights Sold*	*n/a*	*n/a*	*n/a*	*n/a*	*245 089*
** Spending per Tourist (Rand/day)*	*n/a*	*n/a*	*n/a*	*n/a*	*1 959*
** Water per tourist (m^3/day)*	*n/a*	*n/a*	*n/a*	*n/a*	*0.40*

3.3.13 Matigule / Mlazi economic zone

This zone includes the Mtunzini magisterial area, complicated by the fact that part of the Empangeni complex are included in this magisterial district and is it difficult to isolate all the activities in the correct zone. The Amatikulu Sugar Mill is north of the Tugela in the Mtunzini magisterial district, but does not fall in this economic zone.

3.3.13.1 Commercial Forestry Sector

The Commercial Forestry in the sector represents 3 500 hectares.

Table 3.34: Matigule / Mlazi – Commercial Forestry

Parameters	Gum	Pine
Forestry Hectares	1 440	1 864
Production (Tons/ha)	25	15
Production (Gross Income)	16 263	8 488
Direct Employment/ha	0.06	0.06
Estimated Water Usage (m^3/ha)	1 377	771

3.3.13.2 Commercial Agriculture Sector

No irrigation activities could be identified in the economic zone.

3.3.13.3 Industry Sector

A small saw mill is present in the economic zone which services the commercial forestry plantations as mentioned above.

Ticor South Africa produces Titanium-oxide (TiO_2) and is currently investigating the possibility to expand their operations to the Mtunzini area by mining the sand dunes.

Table 3.35: Matigule / Umlazi – Industry

	Saw Mills	**Eco-Tourism**
Turnover (R Million)	23	417
Direct Employment/ha	103	1 948
Current water usage [Mm^3]	0.03	0.056
Eco-Tourism		
** Estimated Number of Bed Nights Sold*	*n/a*	*139 795*
** Spending per Tourist (Rand/day)*	*n/a*	*2 983*
** Water per tourist (m^3/day)*	*n/a*	*0.40*

4 VALUE OF THE CURRENT ECONOMIC ACTIVITIES IN THE USUTU TO MHLATUZE CATCHMENT

4.1 Overview

As previously stated a number of large water users have been identified, the data and information related to these users has been collated and analysed using the Water Impact Model. The model used was adapted to provide social and economic value of the following subsections based on their current water allocations:

- Commercial forestation and accompanying saw milling, pulp and wood chip units based on the current water allocations.
- Irrigation and specifically sugar cane production and sugar mills.
- Mining, open cast, underground and sand heavy metal extraction. .
- The large industry activities in the Richards bay/Empangeni complex, and
- The very important eco-tourism sector with its dependency on the precious nature conservation, rivers and beaches.

4.2 Building of the Water Impact Model

4.2.1 Structure of the Macro Economic Impact Model (MEIM)

The Macro Economic Impact (MEIM) model as it is currently constructed is in the form of a dynamic computerised water entitlement model that can be used to identify and quantify the following indicators.

- Economic value added from use of the water allocation by the existing economic sectors.
- Maximum possible water reduction up to the threshold levels for negative impact to the economic and social wellbeing of communities in the catchments and beyond.
- Proposed water reduction.
- Capitalised impact.

The MEIM once it is customized to incorporate water as part of its operation is then called a Water Impact Model (WIM) to differentiate it from models not accommodating water.

Despite the fact that farm sizes are far from being definitive, the model includes the ability to analyse three different farm sizes, *viz*., small, medium and commercial. This feature provides a facility for determining whether there are impacts that are specific to different scales of farming operations.

As a first step the macro-economy of the basin was established and then sub-divided into its sub-catchments. Production and employment data were used for the catchments and its sub-catchments. A Macro Economic Impact model was constructed for the whole catchment and the identified sub-catchments. The model uses water as the main variable and gives the direct and indirect/induced economic and social value of the water allocation for the following activities; agriculture; forestry:

industry and households. For agriculture the model can accommodate up to ten individual products and for forestry it makes provision for pine, wattle and gum sub-species.

The following direct impacts are estimated by the Macro-Economic Impact Model:

- Gross Domestic Product.
- Low Income Households and Total Households.
- Employment Creation.

A group of economic multipliers was then developed for comparing different water use activities in terms of Gross Domestic Product (GDP/m^3), employment creation (number/Mm^3) and the low-income households.

4.2.2 Input Structures

The Water Impact Model comprises various sub-models which are used in determining the values of the above economic variables. These are described in detail below.

The major driver of valuation using the Macro Economic Impact (MEIM is the the water allocation to each socio-economic activity in each sub-catchment, including the following inputs into the model which are held constant in the modelling:

- The level of water assurance given to each water user in each sub-catchment.
- Area under irrigation in hectares.
- The level of production for the current water allocation taking into account the level of water allocation efficiencies.
- Economic Data in the form of a Social Accounting Matrix (SAM).
- Economic Multipliers.

4.2.3 Multipliers Incorporated into the Water Impact Model

By using a SAM applicable to the study area, multipliers have been calculated. The multipliers that were used in this study to determine the economic value for the water allocations to the different economic activities dependent on water include the following:

- Economic growth (i.e. the impact on GDP) per unit of water allocated.
- Number of jobs created (i.e. the impact on labour requirements) per unit of water allocated
- Income distribution (i.e. the impact on low-income households) per unit of water allocated

An example of the agriculture sector multipliers used in this study includes the following:

- Direct effect: refers to the multipliers as a direct result of productivity in the agriculture sector for the water allocated.

- Indirect effects: refer to those multipliers as a result of activities in the different economic sectors that link backward to agriculture due to the supply of intermediate or secondary inputs, i.e. fertilisers, seeds, etc.

- Induced effects: refers to the chain reaction triggered by the salaries and profits (less retained earnings) that are ploughed back into the economy in the form of private consumption expenditure.

4.3 Valuation of water use for irrigated agriculture

The inputs towards the irrigation sector consist of Computer Based Budget (COMBUD) that were applied to a farm model. The **figure 4.1** below shows the structure of how the Net Farm Income is calculated.

The Combud budgets compiled by the Department of Agriculture were used as base documents to develop the 2007/2008 production budgets. They were updated and adapted for the different production areas in terms of yield, production prices and input costs. The Combud budget provided data up to Gross Margin on a hectare basis, after which the fixed costs are subtracted to get Net Farm Income per hectare and in the end the Net Income or Profits per hectare.

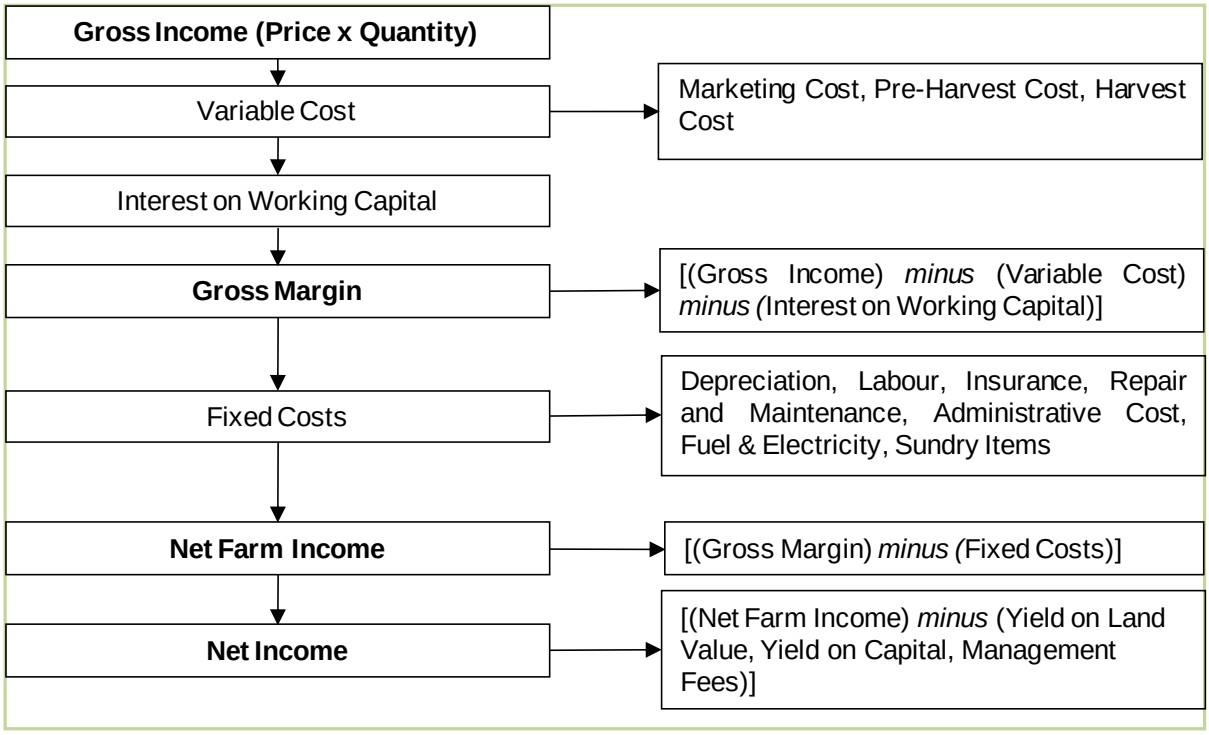


Figure 4:1 Irrigation budget structure

For the use of the macro-economic impact determination these costs in the budget are allocated to structures in such a way that it is allocated to the different sectors of the economy. These will be applied to determine the direct, indirect and induced effects.

Total costs (intermediate inputs and labour requirements).
Agriculture.
Mining.
Manufacturing (fuel, fertilizer, pharmaceuticals and other).
Electricity.
Water.
Construction.
Trade and accommodation.
Transport and communication.
Financial and business services.
Community services.
Salaries and wages: (skilled, semi-skilled and unskilled).

Figure 4:2 Structure of production costs

4.4 Valuation of water use by industries

The path followed by the industries; namely mining and power generation consist of the inputs of production as a result of the water allocation for the water intensive industries, the turnover or economic value added as a result of the level of production and direct employment. The following step is to determine the costs and divide those with the structure of the economy. Their multipliers, calculated from the SAM, are then used to determine the baseline economic value and the economic value to any change in available.

4.4.1 Industry Economic Multipliers

The total extent of economic activity, direct plus indirect impact relative to the estimated direct impact, will be derived from the SAM in the form of multipliers for different sectors from the SAM. All economic models incorporate a number of “multipliers” that form the nucleus of the modelling system. The nature and extent of the impact of a change in a specific economic quantity (e.g. exports), on another economic quantity or quantities (e.g. production output or employment), is determined by a “multiplier”.

A multiplier summarises the total impact that can be expected from change in a given economic activity. **Figure 4.3** below illustrates the multiplier concept that was used in assessing the economic activity in the Usutu-Mhlathuze River catchments due to different levels of water allocations in the available water to the users undertaking economic activities for different EWR scenarios. The assumption made is that for all EWR scenarios, the water requirements to meet the ecological objectives of that scenario are provided first before all other users regardless of their economic

importance. It is however important to note that for this study the assessment was based on the current water allocation based on the present ecological state of the catchments. Any changes to the ecological water requirements will have different impacts on the socio-economy of the different economic zones. Some will be impacted positively while other will be affected negatively depending on the recommended EWR.

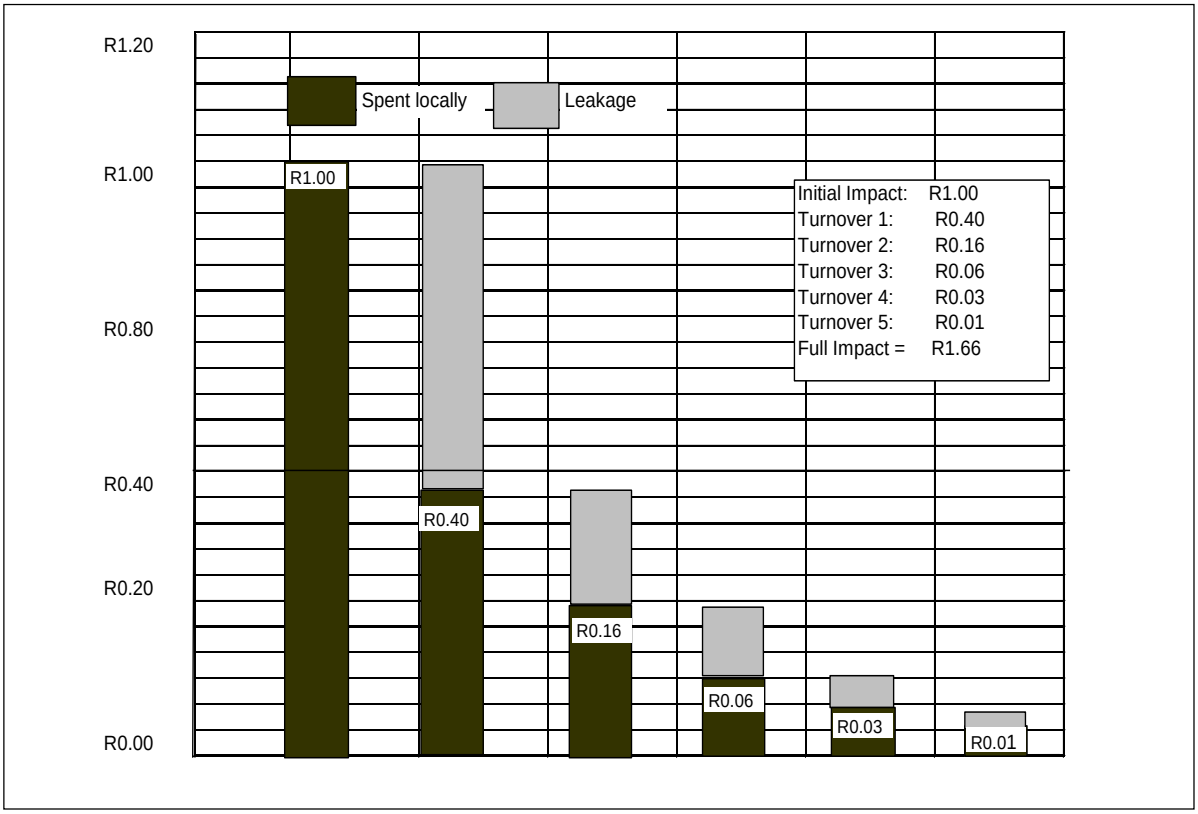


Figure 4:3 Multipliers and turnover

As an example of the economic multiplier effect, assume that R1 is received into the local economy of a catchment from sales beyond the catchment borders per unit of water allocation in the catchment. Of this one Rand, 40 cents is spent on the goods and services within the catchment. The economic sectors and individuals who receive the 40 cents spend 16 cents within the catchment. Of the 16 cents, only six (6) cents is spent locally and so on. The total amount of money received by local firms and residents as a result of the initial R1 in added exported[5] earnings is R1.66. Therefore the multiplier is R1.66.

The change in the level of production in a particular economic activity, as a result of the change in one factor of production such as water supply to a particular sector, is measured by different multipliers. Four multipliers which are commonly used to assess the impacts of the sales (turnover) as a result of level of production for a specific water allocation resulting from a change in sales, usually called final

[5] By export this does not necessarily mean international exports but rather sales beyond the catchment boundary.

demand in multiplier analysis, will be used. The four are: (1) Output, (2) Employment; (3) Income; and (4) Value Added Multipliers.

Leaving all other input factors constant and changing the main variable in this case which is water allocation, this will result in a change in production and therefore sales. This will change the four economic multipliers as a result.

Methodology for calculating sectoral multipliers

Sectoral multipliers will be calculated using information contained in the Limpopo and Gauteng SAM and data obtained from the Reserve Bank of South Africa and Statistics South Africa. These inverse matrices capture all of the direct and indirect relationships among the inputs and outputs of the various entities included in the SAM.

Direct GDP, labour and capital multipliers for each sector are calculated using the following formula:

$$\text{GDP multiplier} = \frac{\text{Value Added}}{\text{Production}}$$

$$\text{Labour multiplier} = \frac{\text{Employment}}{\text{Production}}$$

$$\text{Capital multiplier} = \frac{\text{Capital stock}}{\text{Production}}$$

4.5 Baseline Economic Valuation

4.5.1 General

The following sections present a detailed set of results from the Water Impact Model are presented high lighting the importance and dependency of the economy on the availability of the water. This is the current situation expressed in 2012 prices which will be used to estimate, if necessary any deviation if specific scenario is proposed.

4.5.2 Usutu / Assegai economic zone

The following table and graphs presents a picture of the current contribution of the large water users to the economy of the Usutu/Assegai economic zone.

Commercial forestry is the largest contributor to the GDP of the catchment and is followed by the heavy industries located in Piet Retief. It contributes the most to the GDP of Usutu at R1 880 million. Heavy industry and mining also contributes significantly with a GDP value of R1 509.75 million.

Forestry provides the most direct and indirect jobs 11 090, 59% and 9219 respectively while sawmills, heavy industry and mining also provide a significant amount of jobs.

Forestry provides the biggest contribution to low income households in Usutu at a total of R621.83 million which accounts for 39% of the low income households. This is followed by industry and mining with a total of R526.88 million which accounts for 33% of the low income households.

Table 4.1: Macro-Economic parameters of the Usutu / Assegai economic zone (2012 prices)

		Agriculture	Forestry	Saw Mills	Heavy Industry and Mining	Tourism	ER3 Total
GDP (Rand Millions)	Direct Impact	R 52.59	R 920.04	R 515.77	R 717.72	R 57.80	**R 2 263.92**
	Indirect and induced impact	R 71.67	R 959.74	R 566.82	R 792.04	R 50.91	**R 2 441.17**
	Total Impact	R 124.25	R 1 879.77	R 1 082.60	R 1 509.75	R 108.72	**R 4 705.09**
Labour (Numbers)	Direct Impact	803	11090	4776	1680	480	**18829**
	Indirect and induced impact	632	9219	4509	6250	398	**21008**
	Total Impact	1434	20309	9285	7930	878	**39837**
Low-income households (Rand Millions)	Direct Impact	R 2.34	R 171.39	R 122.36	R 166.94	R 8.73	**R 471.75**
	Indirect and induced impact	R 32.64	R 450.44	R 257.71	R 359.94	R 22.72	**R 1 123.45**
	Total Impact	R 34.97	R 621.83	R 380.07	R 526.88	R 31.45	**R 1 595.20**
Total households (Rand Millions)	Direct Impact	R 7.50	R 549.95	R 201.39	R 275.46	R 19.86	**R 1 054.16**
	Indirect and induced impact	R 127.20	R 1 751.74	R 1 010.80	R 1 412.29	R 89.08	**R 4 391.11**
	Total Impact	R 134.70	R 2 301.69	R 1 212.19	R 1 687.75	R 108.95	**R 5 445.27**

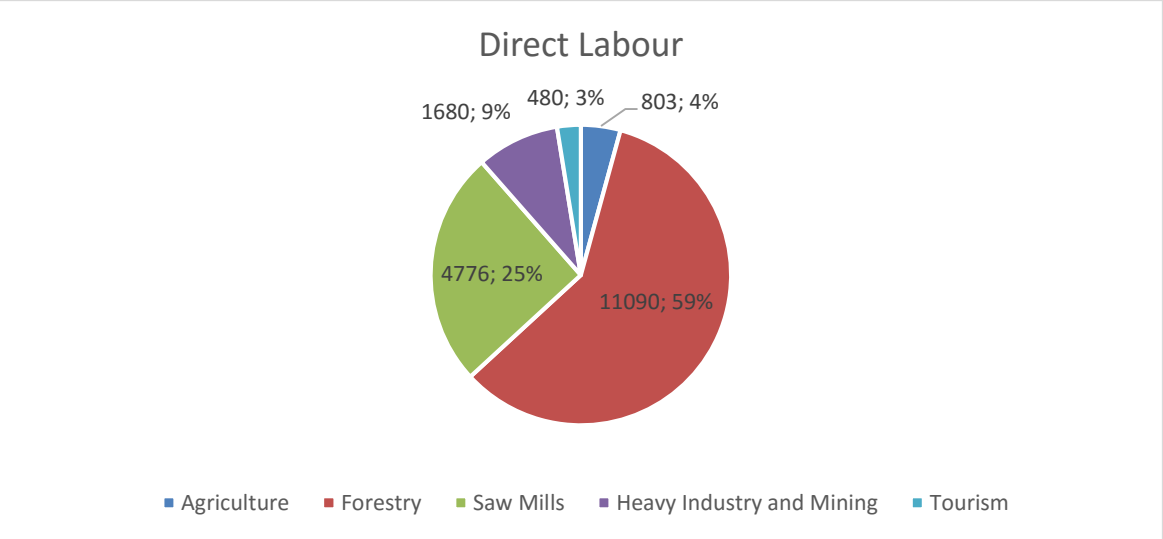


Figure 4:4: Composition of direct labour in the Usutu / Assegai economic zone

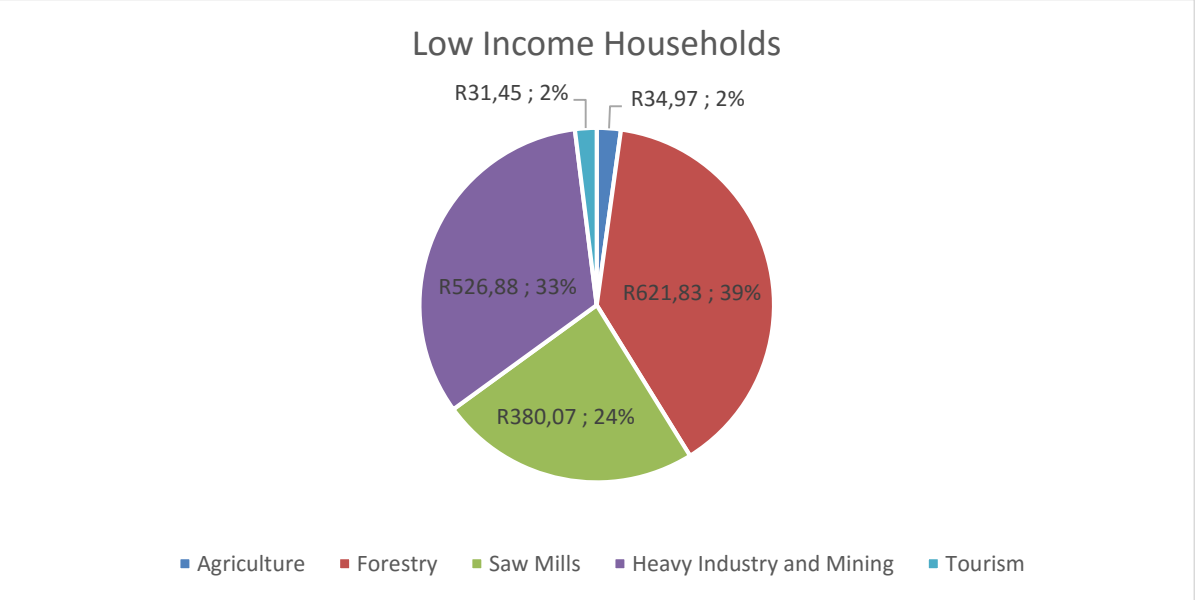


Figure 4:5: Composition of low income households in the Usutu / Assegai economic zone

When taking into account the current water use to commercial forestry as streamflow reduction activity, agriculture, sawmills and heavy industry and mining, the significant contributor per unit of water use/allocated are the secondary industries. However, these are dependent on the primary sectors such as forestry in the case of sawmills. The focus has been on the primary sectors agriculture and forestry. Of the two the significant contributor to the economic value added and employment, irrigation agriculture contributes 12% more to the GDP than commercial forestry in the region. If curtailment is required to provide water to meet the ecological water requirements in this economic zone, the recommendation is the curtailment of commercial forestry first before other sectors. This is because it provides less contribution to the GDP as well as its impact on the employment including low income households.

Table 4.2: Comparison of the sector for each unit of water used/allocated

Parameters	Agriculture	Forestry	Sawmills	Heavy Industries & Mining	Tourism
Gross Domestic Product (R million)	124.25	1879.77	1082.6	1509.75	108.72
Water use (million m^3/a)	12.32	213.05	1.3	0.57	4.738
GDP per m3 of water used	10.08	8.82	832.77	2,648.68	22.95
Total Households employed	814.71	11,966.10	4776	1680	480

Water use	12.32	213.05	1.30	0.57	4.74
Households per million m3 of water used	66.00	56.00	3,674.00	2,947.00	101.00

4.5.3 Upper Pongola economic zone

Table 4.3 below and the graphs present a picture of the current contribution of the large water users to the social and economic wellbeing of the Upper Pongola economic zone based on the current water use/allocation to the existing water users.

Table 4.3: Macro-Economic parameters of the Upper Pongola economic zone (2012 prices)

		Agriculture	Forestry	Saw Mills	Heavy Industry and Mining	Sugar Mills	Tourism	ER2 Total
GDP (Rand Millions)	Direct Impact	R 233.37	R 411.83	R 230.87	R 35.78	R 420.41	R 208.06	**R 1 540.33**
	Indirect and induced impact	R 344.93	R 429.60	R 253.72	R 39.48	R 485.49	R 183.27	**R 1 736.49**
	Total Impact	R 578.30	R 841.44	R 484.60	R 75.26	R 905.90	R 391.33	**R 3 276.82**
Labour (Numbers)	Direct Impact	3427	4964	2138	85	450	1729	**12793**
	Indirect and induced impact	2789	4127	2018	312	4115	1433	**14795**
	Total Impact	6216	9091	4156	397	4565	3162	**27587**
Low-income households (Rand Millions)	Direct Impact	R 17.79	R 76.72	R 54.77	R 8.32	R 90.14	R 31.42	**R 279.15**
	Indirect and induced impact	R 160.40	R 201.63	R 115.36	R 17.94	R 220.08	R 81.79	**R 797.21**
	Total Impact	R 178.19	R 278.35	R 170.13	R 26.27	R 310.22	R 113.21	**R 1 076.37**
Total households (Rand Millions)	Direct Impact	R 40.35	R 246.17	R 90.15	R 13.73	R 151.03	R 71.49	**R 612.92**
	Indirect and induced impact	R 626.12	R 784.13	R 452.46	R 70.40	R 859.75	R 320.66	**R 3 113.52**
	Total Impact	R 666.47	R 1 030.30	R 542.61	R 84.14	R 1 010.77	R 392.16	**R 3 726.44**

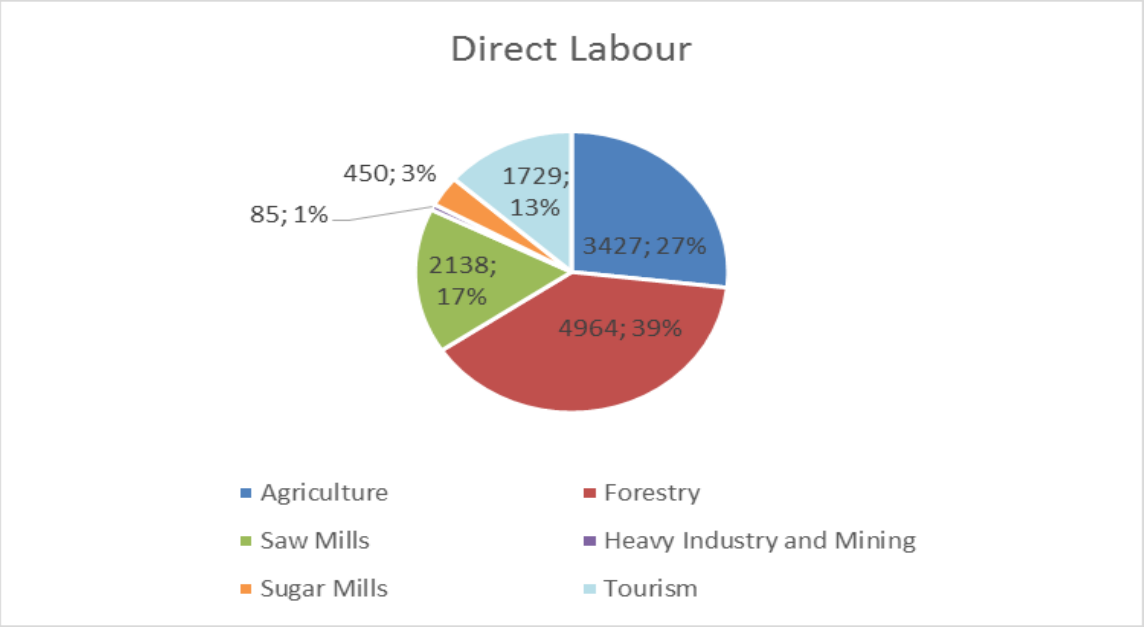


Figure 4:6: Composition of direct labour in the Upper Pongola economic zone

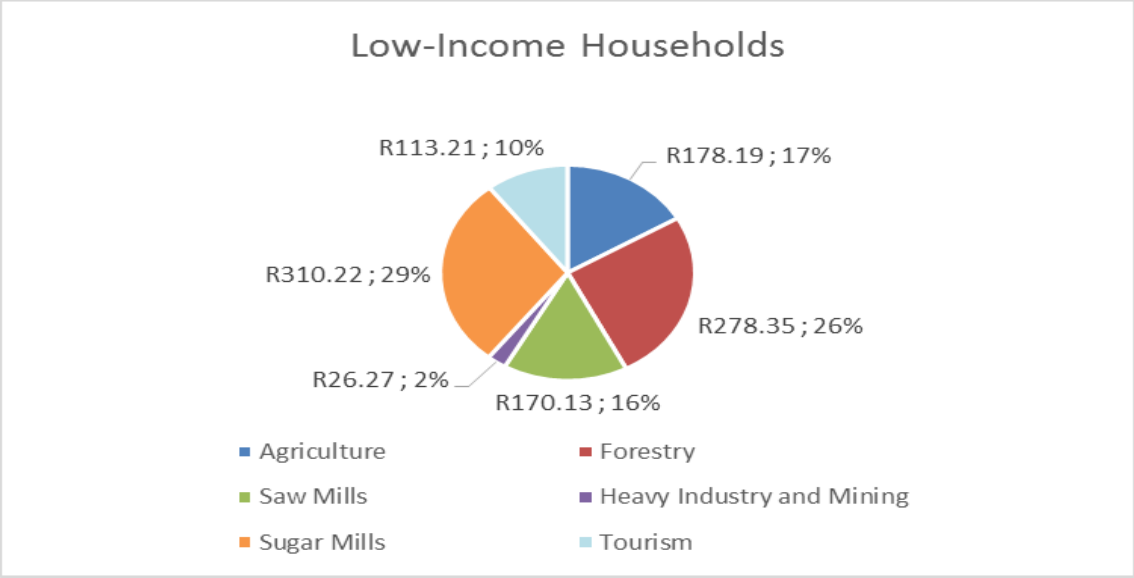


Figure 4:7: Composition of low income households in the Upper Pongola economic zone

The GDP for Upper Pongola has a total value of R3 276.82 million of which sugar mills has the largest contribution at R905.90 million.

The biggest supplier of jobs in this section is forestry with 4 964 direct, 39% and 4 127 indirect jobs. This amount of jobs is because of the multiplier effect that forestry has, even though it does not have the largest contribution to GDP.

Low-income households benefit most from the sugar mill with a value of R310.22 million, 29%. Forestry, agriculture and saw mills also contribute significantly to low income households with values of R278.35 million, R178.19 million and R170.13 million respectively.

When taking into account the current water use to the sectors, tourism including eco-tourism is significant in the upper Pongola catchment agriculture in terms of per unit of water used. It also employs more people per unit of water used/allocated (see **Table 4.4** below). However although agriculture is not a major contributor to the GDP and total households employed which is mainly sugarcane farming, the sugar mill dependent on agriculture contributes significantly to the GDP and number of households employed.

Commercial forestry and the related saw mills are also significant contributors to the GDP and employment. Both commercial forestry and agriculture are significant contributors to the economic value added and employment. Therefore, if curtailment is required to provide water to meet the ecological water requirements in this economic zone, the recommendation is that curtailment will need to be done to both commercial forestry as well as agriculture.

Table 4.4: Comparison of the sector for each unit of water used/allocated

Parameters	Agriculture	Forestry	Sawmills	Heavy Industries & Mining	Sugar Mills	Tourism
Gross Domestic Product (R million)	578.30	841.44	484.6	75.26	905.9	391.33
Water use (million m^3/a)	179.64	77.56	0.58	0.29	2	0.074
GDP per m3 of water used	3.22	10.85	835.52	259.52	452.95	5,288.24
Total Households employed	6216	9,091.00	4156	397	4565	3162
Water use	179.64	77.56	0.58	0.29	2.00	0.07
Households per million m^3 of water used	35.00	117.00	7,166.00	1,369.00	2,283.00	42,730.00
Low Income Households	178.19	278.35	170.13	26.27	310.22	113.21
Water use	179.64	77.56	0.58	0.29	2.00	0.07
Income to low income households per million m3 of water used	1.00	4.00	293.00	91.00	155.00	1,530.00

4.5.4 Lower Pongola economic zone

The following table and graphs presents a picture of the current contribution of the large water users to the economy of the Lower Pongola economic zone.

Table 4.5: Macro-Economic parameters of the Lower Pongola economic zone (2012 prices)

		Agriculture	Heavy Industry and Mining	Tourism	ER1 Total
GDP (Rand Millions)	Direct Impact	R 249.85	R 28.14	R 80.43	**R 358.43**
	Indirect and induced impact	R 348.25	R 31.06	R 70.85	**R 450.15**
	Total Impact	R 598.10	R 59.20	R 151.28	**R 808.58**
Labour (Numbers)	Direct Impact	5235	88	668	**5992**
	Indirect and induced impact	2850	245	554	**3649**
	Total Impact	8086	333	1222	**9641**
Low-income households (Rand Millions)	Direct Impact	R 17.34	R 6.55	R 12.15	**R 36.03**
	Indirect and induced impact	R 155.78	R 14.11	R 31.62	**R 201.51**
	Total Impact	R 173.12	R 20.66	R 43.77	**R 237.54**
Total households (Rand Millions)	Direct Impact	R 49.12	R 10.80	R 27.64	**R 87.56**
	Indirect and induced impact	R 608.94	R 55.37	R 123.96	**R 788.28**
	Total Impact	R 658.06	R 66.18	R 151.60	**R 875.83**

The lower Pongola has the lowest contribution to the GDP of the Usutu catchment. However, agriculture is significant and contributes the most from the area with a value of R598.10 million out of a total of R808.58 million.

Due to the fact that agriculture is quite labour intensive it provides plenty of jobs, a total of 8 086 with 5 235 direct jobs and 2 850 indirect jobs. It also has the biggest impact on Low-income households with a value of R173.12 million out of a total of R237.54 million.

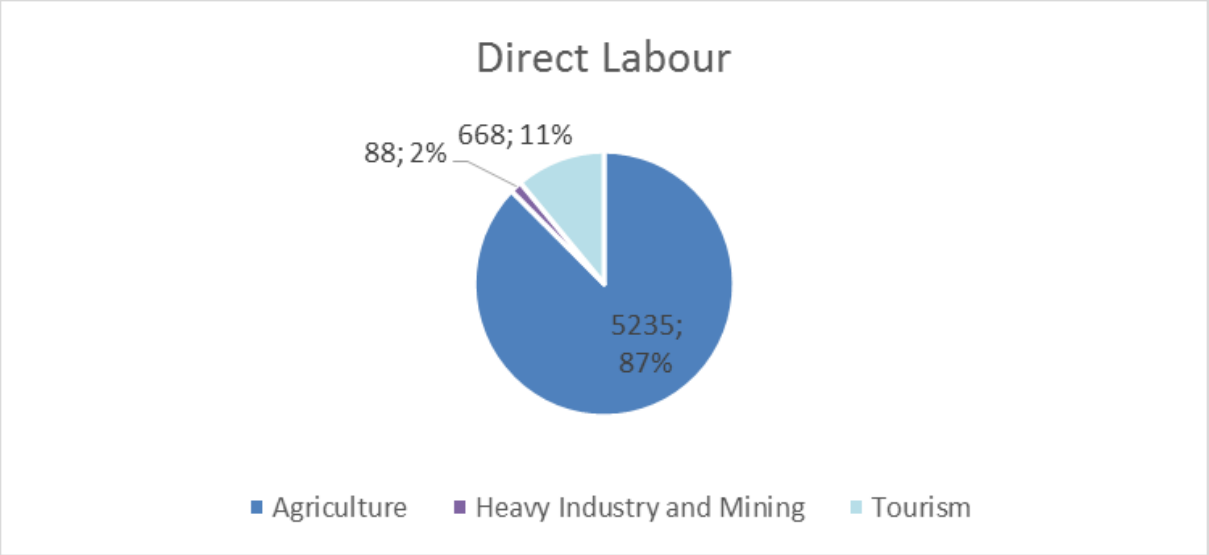


Figure 4:8: Composition of direct labour in the Lower Pongola economic zone

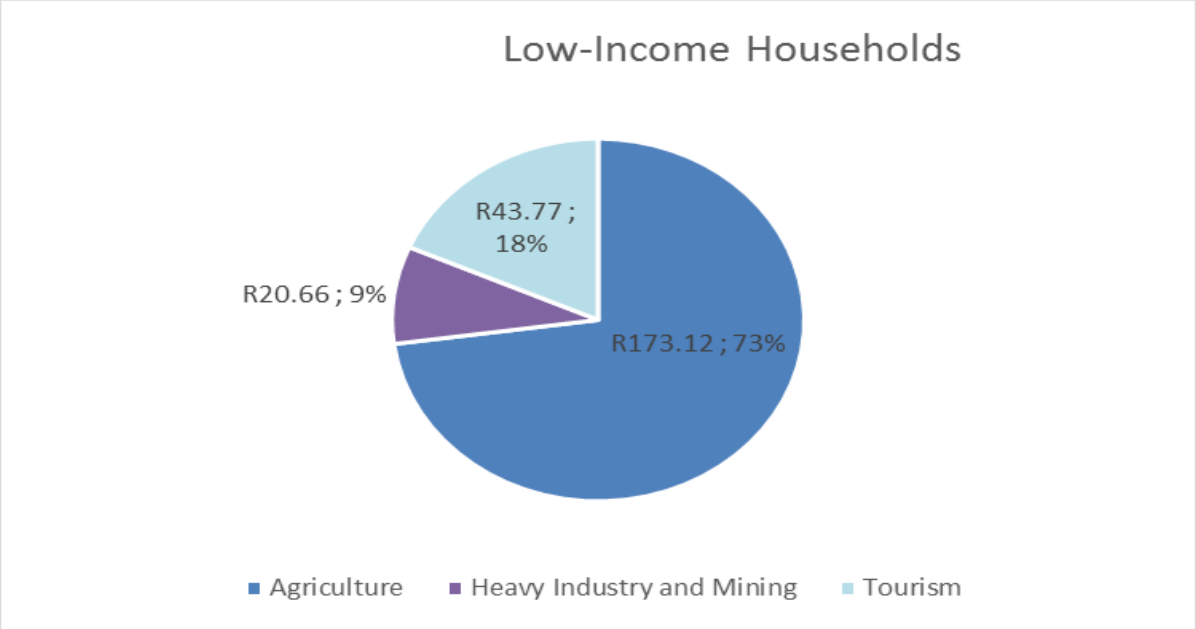


Figure 4:9: Composition of low income households in the Lower Pongola economic zone

When taking into account the current water use to the sectors, tourism including eco-tourism is significant in the lower Pongola catchment in terms of per unit of water used. It also employs more people per unit of water used/allocated (see **Table 4.6** below). This is followed by some mining and then agriculture based on per unit of water use/allocated for production in the sector.

Table 4.6: Comparison of the Pongola catchment for each unit of water used/allocated

Parameters	Agriculture	Forestry	Sawmills	Heavy Industries & Mining	Sugar Mills	Tourism
Gross Domestic Product (R million)	598.10			59.2		151.28
Water use (million m^3/a)	138.28			0.01		0.031
GDP per m3 of water used	4.33	#DIV/0!	#DIV/0!	5,920.00	#DIV/0!	4,880.00
Total Households employed	8086			333		1222
Water use	138.28	-	-	0.01	-	0.03
Households per million m^3 of water used	58.00	#DIV/0!	#DIV/0!	33,300.00	#DIV/0!	39,419.00
Low Income Households	173.12			20.66		43.77
Water use	138.28	-	-	0.01	-	0.03
Income to low income households per million m3 of water used	1.00	#DIV/0!	#DIV/0!	2,066.00	#DIV/0!	1,412.00

Commercial forestry and the related saw mills are also significant contributors to the GDP and employment. Both commercial forestry and agriculture are significant contributors to the economic value added and employment. Therefore, if curtailment is required to provide water to meet the ecological water requirements in this economic zone, the recommendation is that curtailment will need to be done to agriculture first before other sectors are considered. Tourism is significant in the catchment including the value of the ecosystem goods and services because of the floodplains and pans. This is discussed in Chapter 5.

4.5.5 Mkhuze economic zone

The following table and graphs presents a picture of the current contribution of the large water users to the economy of the Mkhuze economic zone.

Table 4.7: Macro-Economic parameters of the Mkhuze economic zone (2012 prices)

		Agriculture	Forestry	Saw Mills	Tourism	ER4 Total
GDP (Rand Million)	Direct Impact	R 119.74	R 148.27	R 84.35	R 146.58	**R 498.94**
	Indirect and induced impact	R 159.36	R 157.91	R 92.70	R 129.11	**R 539.08**
	Total Impact	R 279.10	R 306.18	R 177.05	R 275.69	**R 1 038.02**
Labour (Numbers)	Direct Impact	2397	1814	781	1218	**6210**
	Indirect and induced impact	1294	1517	737	1010	**4558**
	Total Impact	3691	3331	1519	2228	**10768**
Low-income households (Rand Million)	Direct Impact	R 9.39	R 28.51	R 20.01	R 22.14	**R 80.05**
	Indirect and induced impact	R 72.32	R 74.12	R 42.15	R 57.62	**R 246.22**
	Total Impact	R 81.71	R 102.64	R 62.16	R 79.76	**R 326.26**
Total households (Rand Million)	Direct Impact	R 25.10	R 91.50	R 32.94	R 50.37	**R 199.90**
	Indirect and induced impact	R 282.69	R 288.23	R 165.31	R 225.91	**R 962.14**
	Total Impact	R 307.79	R 379.73	R 198.25	R 276.27	**R 1 162.04**

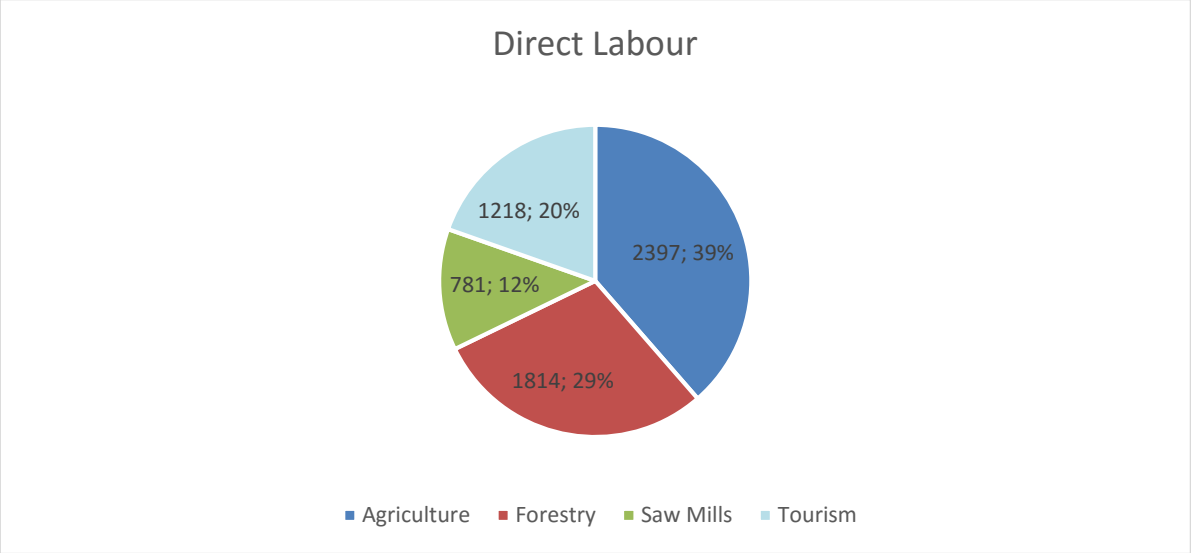


Figure 4:10: Composition of direct labour in the Mkhuze economic zone

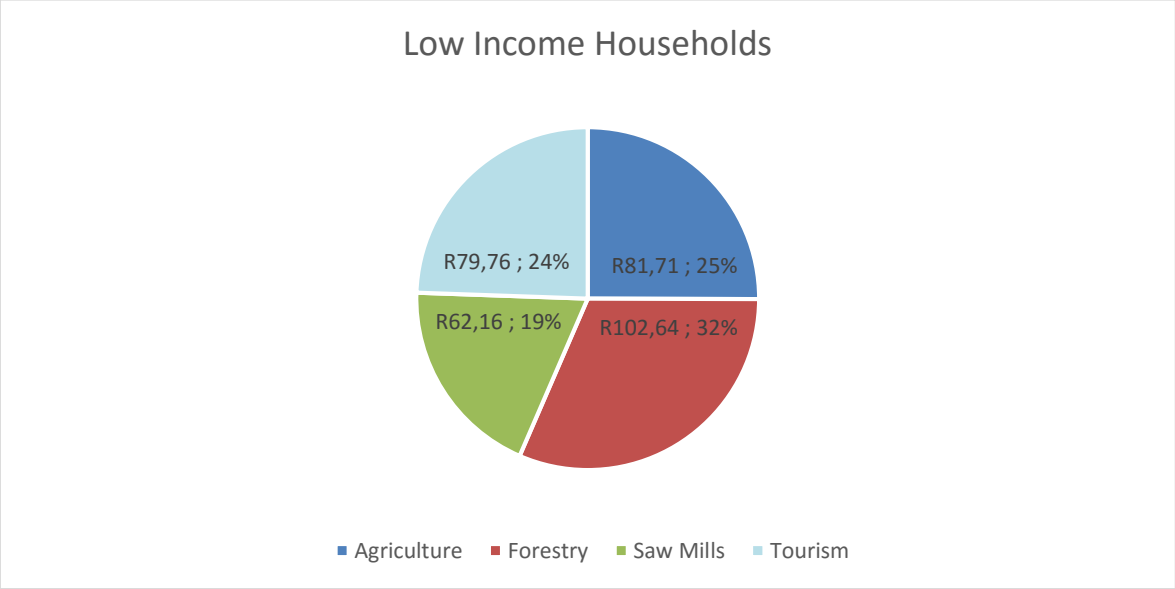


Figure 4:11: Composition of low income households in the Mkhuze economic zone

Forestry has the biggest contribution to GDP at a value of R306.18 million while agriculture and tourism also both contribute significantly at R279.10 million and R275.69 million respectively.

Agriculture provides the largest amount of jobs even though it doesn't have the largest GDP value since agriculture is labour intensive. It provides 2 397 direct jobs, 39% and 1 294 indirect and induced jobs for a total of 3 691.

Low-Income households benefit the most from forestry with a value of R104.64 million, 32% and is followed by agriculture and tourism with values R81.71 million and R79.76 million respectively.

When taking into account the current water use to the sectors, tourism including eco-tourism is significant in the lower Pongola catchment in terms of per unit of water used/allocated. It also employs

more people per unit of water used/allocated (see **Table 4.8** below). This is followed by some mining and then agriculture based on per unit of water use/allocated for production in the sector.

Commercial forestry and the related saw mills are also significant contributors to the GDP and employment. Both commercial forestry and agriculture are significant contributors to the economic value added and employment. Therefore, if curtailment is required to provide water to meet the ecological water requirements in this economic zone, the recommendation is that curtailment will need to be done to both commercial forestry and agriculture first before other sectors are considered. However this will have a knock-on effect on the secondary sectors dependent on the primary sectors. Tourism is significant in the catchment. There is limited eco-tourism in the Mkhuze catchment.

Table 4.8: Comparison of the sector for each unit of water used/allocated – Mkhuze

Parameters	Agriculture	Forestry	Sawmills	Heavy Industries & Mining	Sugar Mills	Tourism
Gross Domestic Product (R million)	279.10	306.18	177.05			275.69
Water use (million m3/a)	71.54	21.89	0.21			0.0335
GDP per m3 of water used	3.90	13.99	843.10	#DIV/0!	#DIV/0!	8,229.55
Total employed	3691	3,331.00	1519			2228
Water use	71.54	21.89	0.21	-	-	0.03
Households per million m3 of water used	52.00	152.00	7,233.00	#DIV/0!	#DIV/0!	66,507.00
Low Income Households	81.71	102.64	62.16			79.26
Water use	71.54	21.89	0.21	-	-	0.03
Income to low income households per million m3 of water used	1.00	5.00	296.00	#DIV/0!	#DIV/0!	2,366.00

4.5.6 White Mfolozi economic zone

The following table and graphs presents a picture of the current contribution of the large water users to the economy of the White Mfolozi economic zone.

Heavy industry and mining contributes the most to the GDP of the White Mfolozi with a value of R678.33 million. Forestry located in the upper catchment also has a significant contribution of R478.64 million.

It follows that heavy industry and mining also contributes the most to employment with 1 540 direct, 37% and 2 808 indirect jobs. This is situated around Vryheid and Ulundi. Low-income households benefit most from heavy industry and mining with a value of R236.73 million, 47%.

Table 4.9: Macro-Economic parameters of the White Mfolozi economic zone (2012 prices)

		Agriculture	Forestry	Saw Mills	Heavy Industry and Mining	Tourism	ER4 Total
GDP (Rand Million)	Direct Impact	R 4.68	R 263.65	R 125.96	R 322.47	R 56.62	**R 773.38**
	Indirect and induced impact	R 6.49	R 214.99	R 138.43	R 355.86	R 49.87	**R 765.64**
	Total Impact	R 11.17	R 478.64	R 264.39	R 678.33	R 106.48	**R 1 539.02**
Labour (Numbers)	Direct Impact	25	1907	1166	1540	470	**5109**
	Indirect and induced impact	61	2075	1101	2808	390	**6435**
	Total Impact	86	3982	2268	4348	860	**11544**
Low-income households (Rand Million)	Direct Impact	R 0.11	R 33.73	R 29.88	R 75.01	R 8.55	**R 147.28**
	Indirect and induced impact	R 3.08	R 102.16	R 62.94	R 161.72	R 22.26	**R 352.15**
	Total Impact	R 3.19	R 135.89	R 92.82	R 236.73	R 30.81	**R 499.43**
Total households (Rand Million)	Direct Impact	R 0.34	R 108.23	R 49.18	R 123.77	R 19.45	**R 300.98**
	Indirect and induced impact	R 11.96	R 397.98	R 246.86	R 634.54	R 87.26	**R 1 378.60**
	Total Impact	R 12.30	R 506.22	R 296.04	R 758.31	R 106.71	**R 1 679.58**

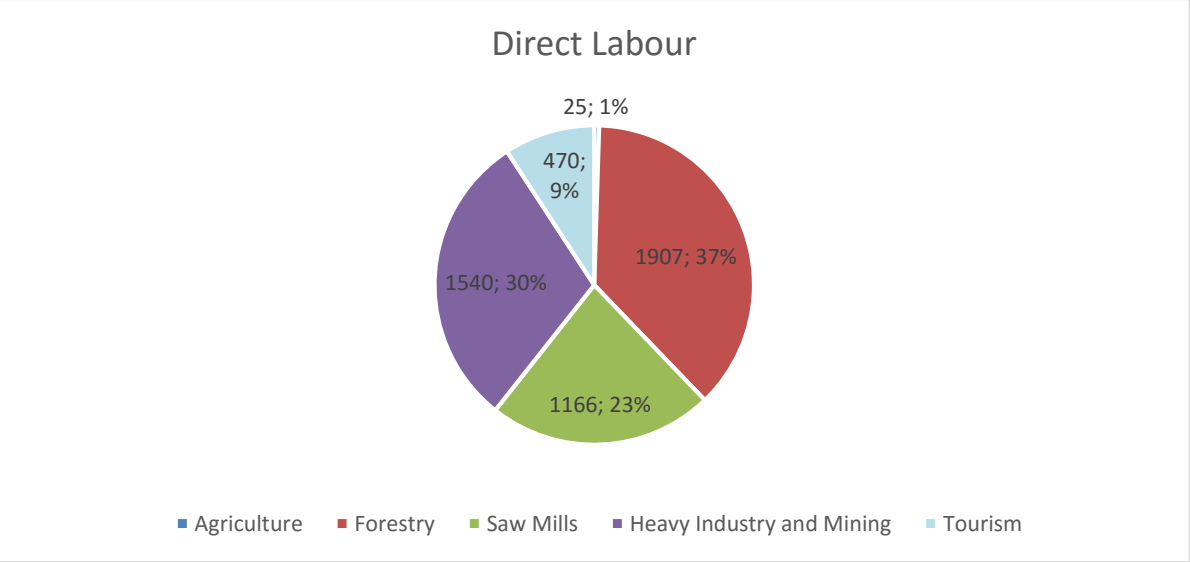


Figure 4:12: Composition of direct labour in the White Mfolozi economic zone

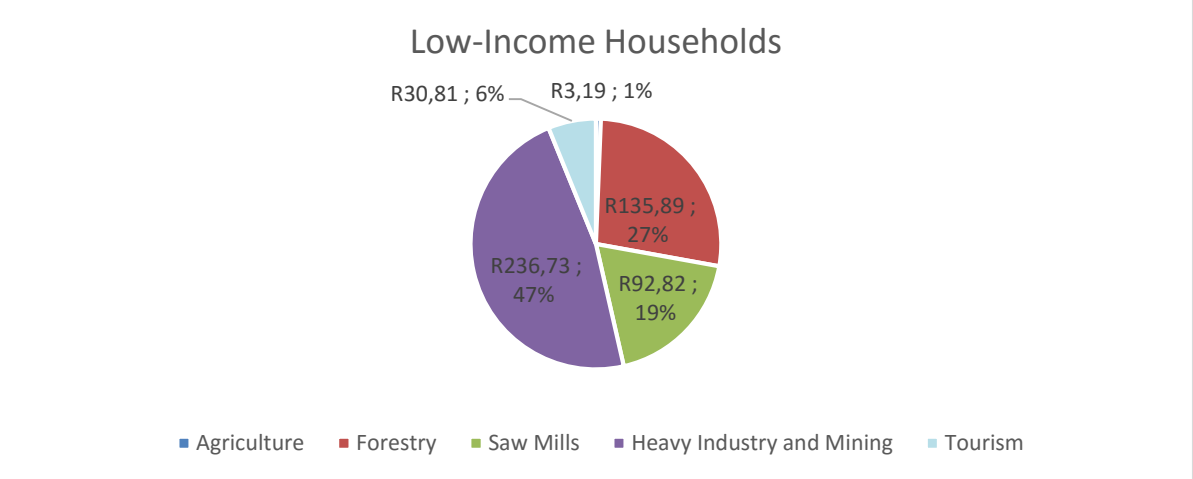


Figure 4:13: Composition of low income households in the White Mfolozi economic zone

When taking into account the current water use to the sectors, sawmills, industries and mining is significant in the Hluhluwe catchment in terms of per unit of water used/allocated. The two sectors also employ more people per unit of water used/allocated (see **Table 4.10** below). The primary sectors of agriculture and forestry do not contribute significantly based on per unit of water use/allocated for production in the sector. However they are important for the downstream secondary sectors.

Table 4.10: Comparison of the sector for each unit of water used/allocated – White Mfolozi

Parameters	Agriculture	Forestry	Sawmills	Heavy Industries & Mining	Sugar Mills	Tourism
Gross Domestic Product (R million)	11.17	478.64	264.39	678.33		106.48
Water use (million m3/a)	2.08	32.49	0.32	0.037		0.0284
GDP per m^3 of water used	5.36	14.73	826.22	18,333.24	#DIV/0!	3,749.30
Total employed	86	3,982.00	2268	4348		860
Water use	2.08	32.49	0.32	0.04	-	0.03
Households per million m3 of water used	41.00	123.00	7,088.00	117,514.00	#DIV/0!	30,282.00
Low Income Households	3.19	135.89	92.82	236.73		30.81
Water use	2.08	32.49	0.32	0.04	-	0.03
Income to low income households per million m3 of water used	2.00	4.00	290.00	6,398.00	#DIV/0!	1,085.00

Commercial forestry and the related saw mills very significant contributors to the GDP and employment. Therefore, if curtailment is required to provide water to meet the ecological water requirements in this economic zone, the recommendation is that curtailment will need to be done to both commercial forestry and agriculture first before other sectors are considered. However this will have a knock-on effect on the secondary sectors dependent on the primary sectors. Tourism is significant in the catchment and will benefit from improving the ecosystem functioning in the catchment. There is limited eco-tourism in the Hluhluwe catchment.

4.5.7 Black Mfolozi economic zone

The following table and graphs presents a picture of the current contribution of the large water users to the economy of the Black Mfolozi economic zone.

Heavy industry and mining is the largest contributor of GDP with a value of R1 257.66 million.

Heavy industry and mining contributes the most to employment with 2 881 direct jobs and 5 206 indirect jobs for a total of 8 087. Agriculture also provides a significant amount of jobs with 2 381 direct and 912 indirect and induced jobs for a total of 3 293.

The industry which benefits low-income households the most naturally follows to be heavy industry and mining with a value of R438.90 million.

Table 4.11: Macro-Economic parameters of the Black Mfolozi economic zone (2012 prices)

		Agriculture	Forestry	Saw Mills	Heavy Industry and Mining	Tourism	ER6 Total
GDP (Rand Million)	Direct Impact	R 87.29	R 111.84	R 53.43	R 597.87	R 21.08	**R 871.51**
	Indirect and induced impact	R 113.28	R 91.19	R 58.72	R 659.78	R 18.56	**R 941.54**
	Total Impact	R 200.57	R 203.03	R 112.15	R 1 257.66	R 39.64	R 1 813.05
Labour (Numbers)	Direct Impact	2381	809	495	2881	175	**6740**
	Indirect and induced impact	912	880	467	5206	145	**7611**
	Total Impact	3293	1689	962	8087	320	14351
Low-income households (Rand Million)	Direct Impact	R 5.87	R 14.31	R 12.68	R 139.07	R 3.18	**R 175.10**
	Indirect and induced impact	R 49.46	R 43.33	R 26.70	R 299.84	R 8.29	**R 427.62**
	Total Impact	R 55.33	R 57.64	R 39.37	R 438.90	R 11.47	R 602.72
Total households (Rand Million)	Direct Impact	R 18.84	R 45.91	R 20.86	R 229.47	R 7.24	**R 322.32**
	Indirect and induced impact	R 193.48	R 168.82	R 104.71	R 1 176.47	R 32.48	**R 1 675.96**
	Total Impact	R 212.31	R 214.73	R 125.58	R 1 405.93	R 39.73	R 1 998.28

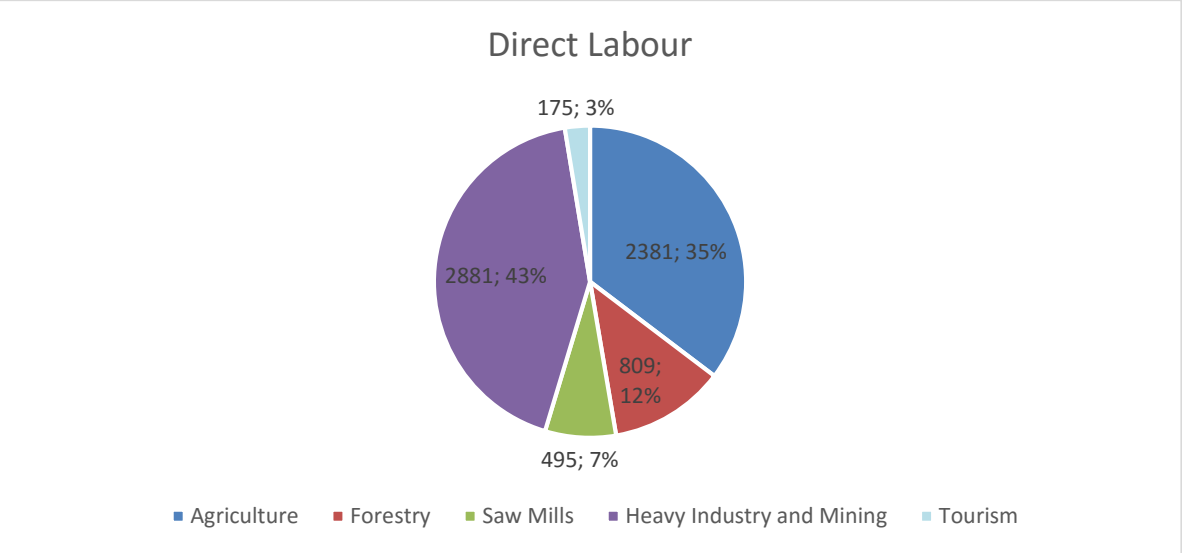


Figure 4:14: Composition of direct labour in the Black Mfolozi economic zone

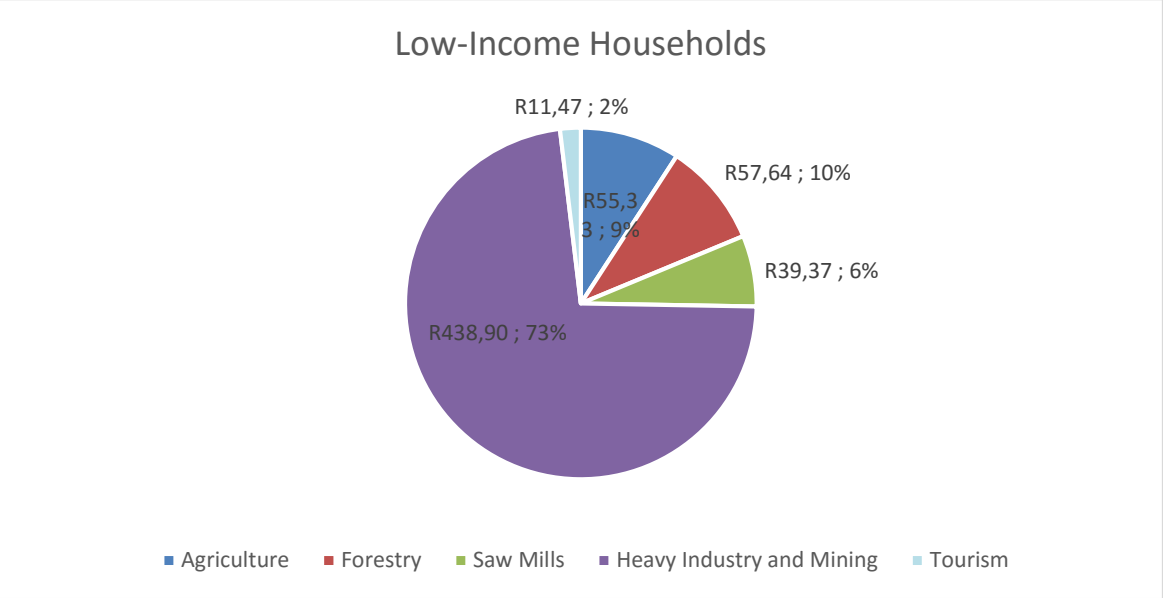


Figure 4:15: Composition of low income households in the Black Mfolozi economic zone

When taking into account the current water use to the sectors, sawmills, industries and mining is significant in the Black Mfolozi catchment in terms of per unit of water used/allocated. The two sectors also employ more people per unit of water used/allocated (see **Table 4.12** below). The primary sectors of agriculture and forestry do not contribute significantly based on per unit of water use/allocated for production in the sector. However they are important for the downstream secondary sectors.

Table 4.12: Comparison of the sector for each unit of water used/allocated – Black Mfolozi

Parameters	Agriculture	Forestry	Sawmills	Heavy Industries & Mining	Sugar Mills	Tourism
Gross Domestic Product (R million)	200.57	203.03	112.15	1257.66		39.64
Water use (million m3/a)	13.99	13.74	0.13	0.375		0.0039
GDP per m3 of water used	14.34	14.78	862.69	3,353.76	#DIV/0!	10,164.10
Total employed	3293	1,689.00	962	8087		320
Water use	13.99	13.74	0.13	0.38	-	0.00
Households per million m3 of water used	235.00	123.00	7,400.00	21,565.00	#DIV/0!	82,051.00
Low Income Households	55.33	57.64	39.37	438.9		11.47
Water use	13.99	13.74	0.13	0.38	-	0.00
Income to low income households per million m3 of water used	4.00	4.00	303.00	1,170.00	#DIV/0!	2,941.00

Commercial forestry and the related saw mills very significant contributors to the GDP and employment. Therefore, if curtailment is required to provide water to meet the ecological water requirements in this economic zone, the recommendation is that curtailment will need to be done to both commercial forestry and agriculture first before other sectors are considered. However this will have a knock-on effect on the secondary sectors dependent on the primary sectors. Tourism is significant in the catchment and will benefit from improving the ecosystem functioning in the catchment. There is limited eco-tourism in the Hluhluwe catchment.

4.5.8 Mfolozi economic zone

The following table and graphs presents a picture of the current contribution of the large water users to the economy of the Mfolozi economic zone.

Table 4.13: Macro-Economic parameters of the Mfolozi economic zone (2012 prices)

		Agriculture	Forestry	Saw Mills	Heavy Industry and Mining	Sugar Mills	Tourism	ER9 Total
GDP (Rand Million)	Direct Impact	R 118.67	R 158.61	R 77.13	R 901.65	R 297.74	R 70.82	**R 1 624.61**
	Indirect and induced impact	R 177.14	R 124.29	R 84.76	R 995.02	R 343.83	R 62.38	**R 1 787.41**
	Total Impact	R 295.81	R 282.90	R 161.89	R 1 896.67	R 641.56	R 133.20	R 3 412.02
Labour (Numbers)	Direct Impact	1632	1317	714	2159	450	588	**6861**
	Indirect and induced impact	1412	1172	674	7852	2915	488	**14512**
	Total Impact	3043	2489	1388	10011	3365	1076	21373
Low-income households (Rand Million)	Direct Impact	R 9.46	R 20.26	R 18.30	R 209.73	R 63.84	R 10.69	**R 332.28**
	Indirect and induced impact	R 82.27	R 58.66	R 38.54	R 452.18	R 155.86	R 27.84	**R 815.36**
	Total Impact	R 91.74	R 78.93	R 56.83	R 661.91	R 219.70	R 38.54	R 1 147.64
Total households (Rand Million)	Direct Impact	R 20.79	R 65.03	R 30.11	R 346.05	R 106.96	R 24.34	**R 593.27**
	Indirect and induced impact	R 321.24	R 228.87	R 151.15	R 1 774.22	R 608.88	R 109.15	**R 3 193.50**
	Total Impact	R 342.02	R 293.90	R 181.26	R 2 120.28	R 715.84	R 133.48	R 3 786.78

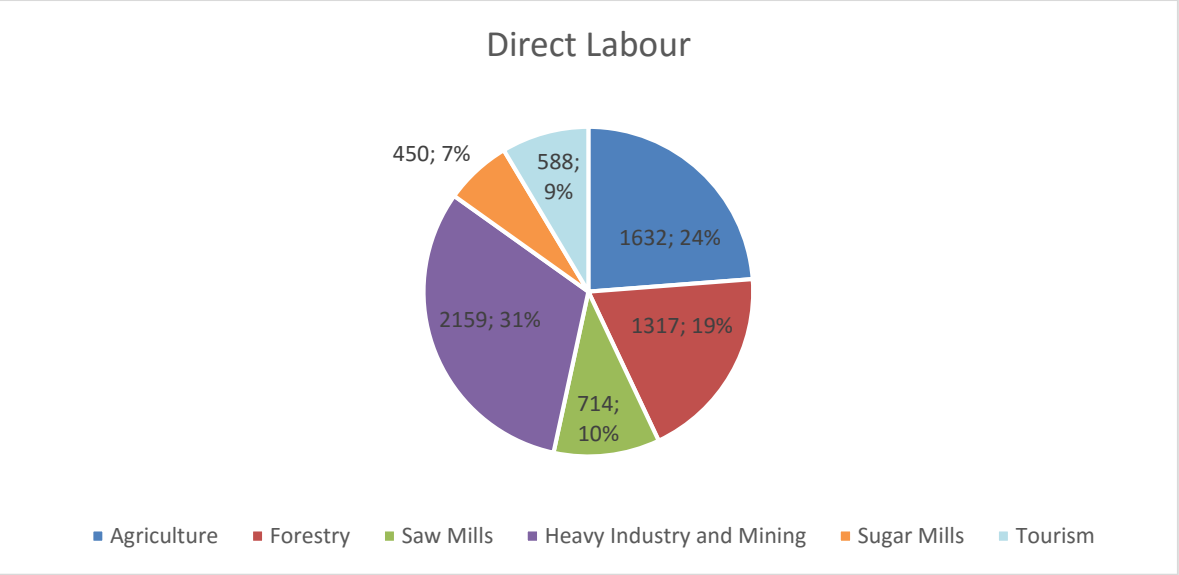


Figure 4:16: Composition of direct labour in the Mfolozi economic zone

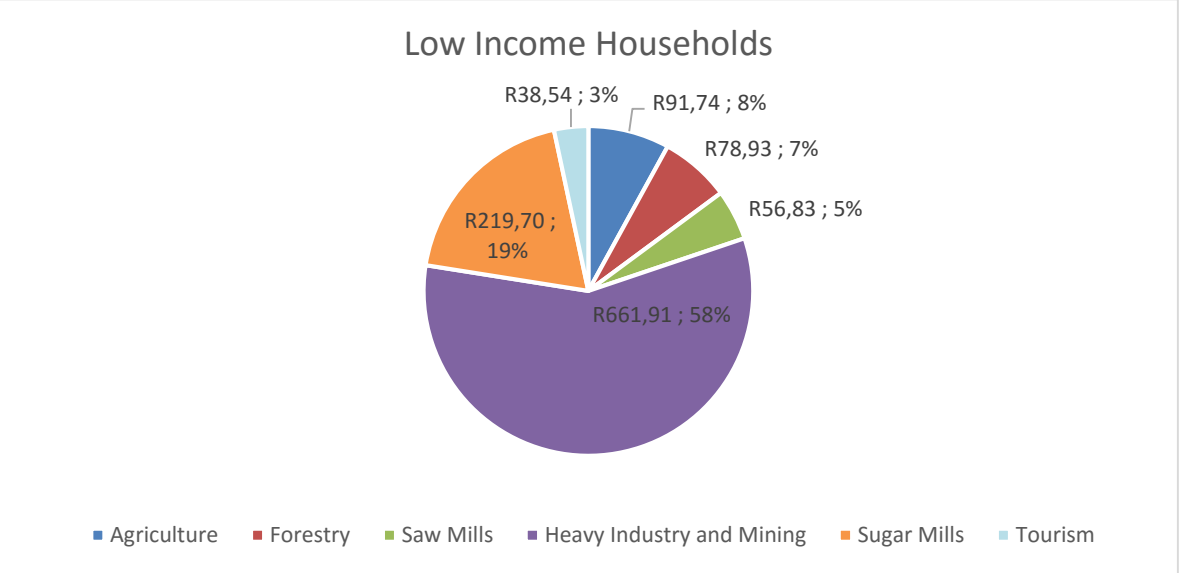


Figure 4:17: Composition of low income households in the Mfolozi economic zone

As in the White and Black Mfolozi regions the Mfolozi regions' GDP is mainly made up of heavy industry and mining with a value of R1 896.67 million. This is because of the heavy mineral sand mining being undertaken by Richards Bay Minerals (RBM). However what is important is the significant contribution of tourism because of Lake St Lucia and surrounds.

It follows that heavy industry and mining also provide the largest number of jobs with 2 159 direct, 31% and 7 852 indirect jobs for a total of 10 011 jobs. Tourism is a significant employer in the area.

Low-income households also benefit most from heavy industry and mining with a value of R661.91 million, 58%. Sugar mills also benefit the low-income households with a value of R219.70 million, 19%.

When taking into account the current water use to the sectors, tourism and sand mining are significant in the Mfolozi catchment in terms of per unit of water used/allocated. The two sectors also employ more people per unit of water used/allocated (see **Table 4.14** below). The primary sectors of agriculture and forestry do not contribute significantly based on per unit of water use/allocated for production in the sector. However they are important for the downstream secondary sectors.

Commercial forestry and the related saw mills also contribute to the GDP and employment but on a limited scale. Therefore, if curtailment is required to provide water to meet the ecological water requirements in this economic zone, the recommendation is that curtailment will need to be done to commercial forestry first before other sectors are considered. However this will have a knock-on effect on the secondary sectors dependent on the primary sectors. Tourism is significant in the catchment and will benefit from improving the ecosystem functioning in the catchment. There is significant eco-tourism in the Mfolozi catchment.

Table 4.14: Comparison of the sector for each unit of water used/allocated – Mfolozi

Parameters	Agriculture	Forestry	Sawmills	Heavy Industries & Mining	Sugar Mills	Tourism
Gross Domestic Product (R million)	295.81	282.9	161.89	1896.67	641.56	133.2
Water use (million m3/a)	113.55	15.70	0.19	0.399	2	0.046
GDP per m3 of water used	2.61	18.02	852.05	4,753.56	320.78	2,895.65
Total employed	3043	2,489.00	1388	10011	3365	1076
Water use	113.55	15.70	0.19	0.40	2.00	0.05
Employment per million m3 of water used	27.00	159.00	7,305.00	25,090.00	1,683.00	23,391.00
Low Income Households	91.74	78.93	56.83	661.91	219.7	38.54
Water use	113.55	15.70	0.19	0.40	2.00	0.05
Income to low income households per million m3 of water used	1.00	5.00	299.00	1,659.00	110.00	838.00

4.5.9 Upper Mhlathuze economic zone

The following table and graphs presents a picture of the current contribution of the large water users to the economy of the Upper Mhlathuze economic zone.

Table 4.15: Macro-Economic parameters of the Upper Mhlathuze economic zone (2012 prices)

		Agriculture	Forestry	Saw Mills	Tourism	ER7 Total
GDP (Rand Million)	Direct Impact	R 337.52	R 160.67	R 90.07	R 137.71	**R 725.97**
	Indirect and induced impact	R 366.06	R 167.61	R 98.99	R 121.29	**R 753.95**
	Total Impact	R 703.58	R 328.28	R 189.06	R 259.00	R 1 479.92
Labour (Numbers)	Direct Impact	6455	1937	834	1144	**10370**
	Indirect and induced impact	3181	1610	787	949	**6527**
	Total Impact	9636	3547	1622	2093	16897
Low-income households (Rand Million)	Direct Impact	R 29.38	R 29.93	R 21.37	R 20.80	**R 101.48**
	Indirect and induced impact	R 173.69	R 78.67	R 45.01	R 54.13	**R 351.50**
	Total Impact	R 203.08	R 108.60	R 66.37	R 74.93	R 452.98
Total households (Rand Million)	Direct Impact	R 83.55	R 96.04	R 35.17	R 47.32	**R 262.08**
	Indirect and induced impact	R 677.05	R 305.92	R 176.52	R 212.23	**R 1 371.72**
	Total Impact	R 760.60	R 401.97	R 211.69	R 259.55	R 1 633.80

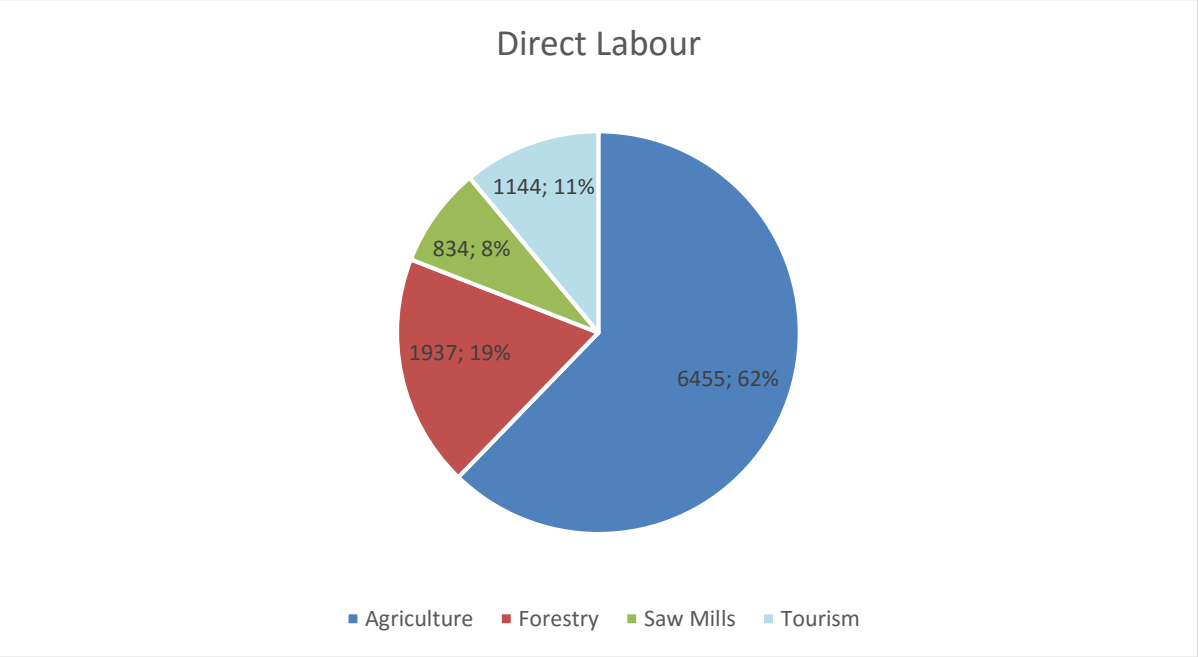


Figure 4:18: Composition of direct labour in the Upper Mhlathuze economic zone

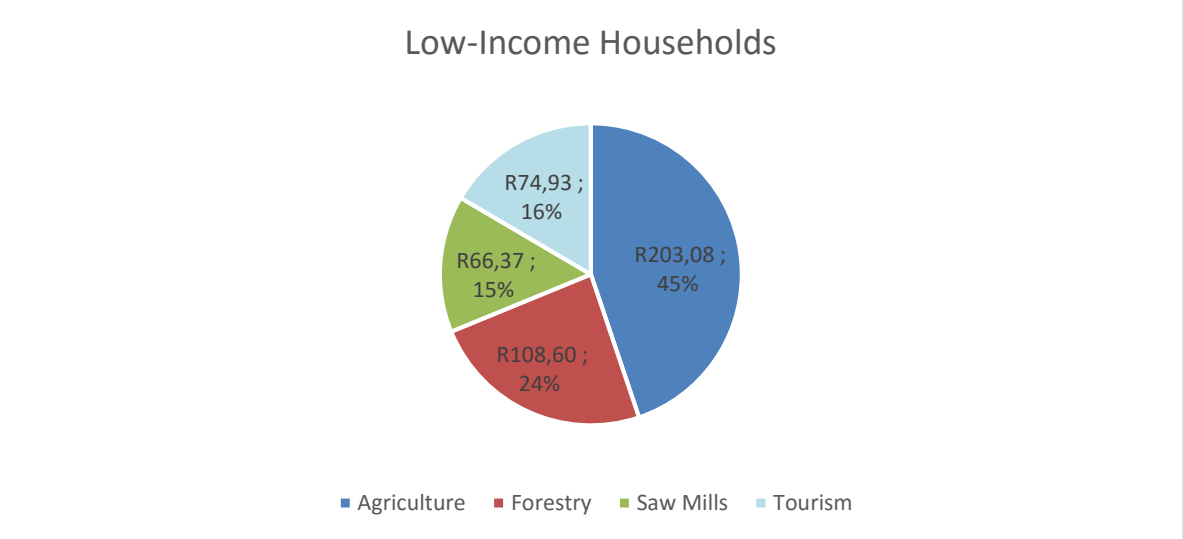


Figure 4:19: Composition low income households in the Upper Mhlathuze economic zone

Agriculture has the largest impact on the GDP of Upper Mhlatuze with a value of R703.58 million followed by forestry and tourism with values R328.28 million and R259.00 million respectively.

Since agriculture is labour intensive it provides a large number of jobs, 6 455 direct, 62% and 3 181 indirect jobs with a total of 9 636 jobs. Forestry provides the second largest amount of jobs with a total of 3 547 jobs while tourism provides a total of 2 093 jobs.

Agriculture provides the most income to low-income households with a value of R203.08 million followed by forestry with a value of R108.60 million.

When taking into account the current water use to the sectors, tourism and agriculture are significant in the Upper Mhlatuze catchment in terms of per unit of water used/allocated. The two sectors also employ more people per unit of water used/allocated (see **Table 4.16** below). The primary sectors of agriculture and forestry do not contribute significantly based on per unit of water use/allocated for production in the sector. However they are important for the downstream secondary sectors.

Commercial forestry and the related saw mills also contribute to the GDP and employment but on a limited scale. Therefore, if curtailment is required to provide water to meet the ecological water requirements in this economic zone, the recommendation is that curtailment will need to be done to commercial forestry first before other sectors are considered. However this will have a knock-on effect on the secondary sectors dependent on the primary sectors. Tourism is significant in the catchment and will benefit from improving the ecosystem functioning in the catchment. There is significant eco-tourism in the Mfolozi catchment.

Table 4.16: Comparison of the sector for each unit of water used/allocated – Upper Mhlatuze

Parameters	Agriculture	Forestry	Sawmills	Heavy Industries & Mining	Sugar Mills	Tourism
Gross Domestic Product (R million)	703.58	328.28	189.06			259
Water use (million m3/a)	189.33	39.32	0.23			0.093
GDP per m3 of water used	3.72	8.35	822.00	#DIV/0!	#DIV/0!	2,784.95
Total employed	9636	3,547.00	1622			2093
Water use	189.33	39.32	0.23	-	-	0.09
Households per million m3 of water used	51.00	90.00	7,052.00	#DIV/0!	#DIV/0!	22,505.00
Low Income Households	203.08	108.60	66.37			74.93
Water use	189.33	39.32	0.23	-	-	0.09
Income to low income households per million m3 of water used	1.00	3.00	289.00	#DIV/0!	#DIV/0!	806.00

4.5.10 Lower Mhlathuze economic zone

The following table and graphs presents a picture of the current contribution of the large water users to the economy of the Lower Mhlathuze economic zone.

It follows from the GDP contribution that heavy industry and mining contribute to 11 392 direct jobs, 40% and 279 574 indirect jobs for a total of 290 966 jobs while the light industry provides 11 449 direct jobs, 41% and 32 162 indirect jobs for a total of 43 611 jobs.

Table 4.17: Macro-Economic parameters of the Lower Mhlathuze economic zone (2012 prices)

		Agriculture	Forestry	Saw Mills	Heavy Industry and Mining	Sugar Mill	Light Industry	Tourism	ER8 Total
GDP (Rand Million)	Direct Impact	R 37.57	R 180.36	R 73.14	R 32 104.64	R 423.71	R 2 994.91	R 269.92	**R 36 084.26**
	Indirect and induced impact	R 50.72	R 106.17	R 80.38	R 35 429.11	R 489.30	R 3 690.81	R 237.75	**R 40 084.24**
	Total Impact	R 88.28	R 286.53	R 153.53	R 67 533.75	R 913.02	R 6 685.73	R 507.66	R 76 168.50
Labour (Numbers)	Direct Impact	734	1249	677	11392	450	11449	2243	**28194**
	Indirect and induced impact	401	963	639	279574	4148	32162	1860	**319745**
	Total Impact	1135	2212	1317	290966	4598	43611	4102	347939
Low-income households (Rand Million)	Direct Impact	R 3.07	R 14.54	R 17.35	R 7 467.67	R 90.85	R 587.68	R 40.76	**R 8 221.91**
	Indirect and induced impact	R 22.80	R 49.03	R 36.55	R 16 100.60	R 221.81	R 1 692.16	R 106.11	**R 18 229.07**
	Total Impact	R 25.87	R 63.57	R 53.90	R 23 568.27	R 312.66	R 2 279.84	R 146.87	R 26 450.98
Total households (Rand Million)	Direct Impact	R 9.84	R 46.65	R 28.56	R 12 321.82	R 152.22	R 1 000.67	R 92.75	**R 13 652.50**
	Indirect and induced impact	R 89.19	R 192.06	R 143.34	R 63 173.93	R 866.50	R 6 611.30	R 415.99	**R 71 492.31**
	Total Impact	R 99.03	R 238.70	R 171.90	R 75 495.75	R 1 018.72	R 7 611.96	R 508.73	R 85 144.81

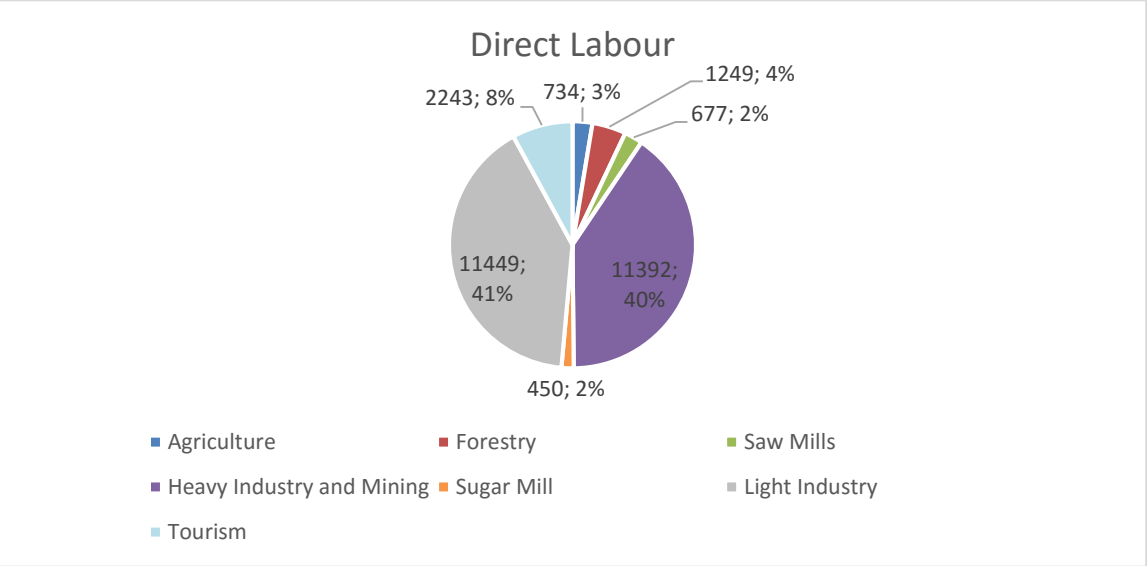


Figure 4:20: Composition of direct labour in the Lower Mhlathuze economic zone

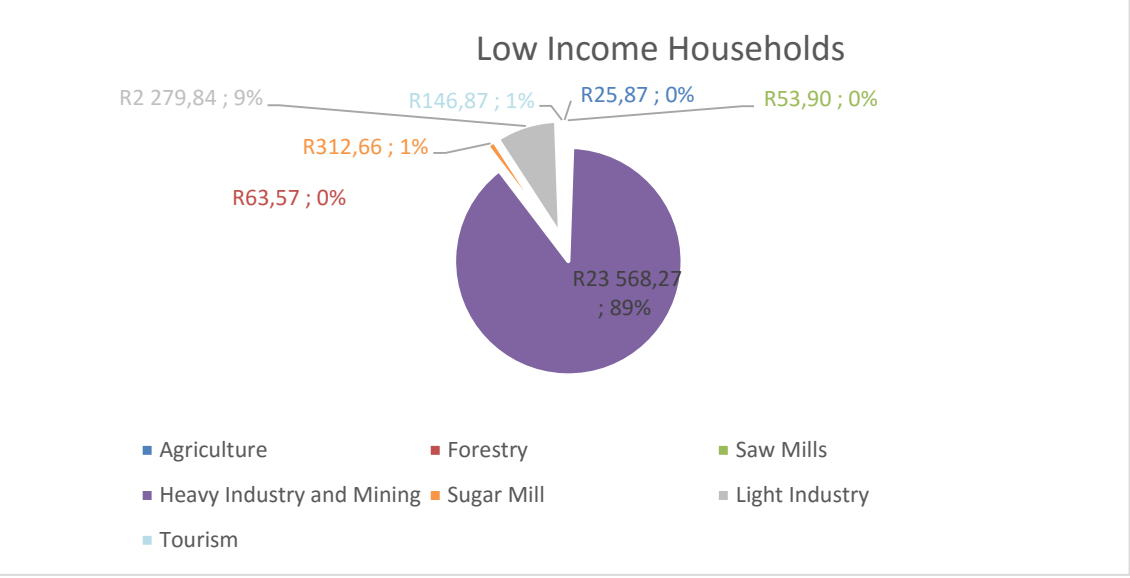


Figure 4:21: Composition of low income households in the Lower Mhlathuze economic zone

In the Lower Mhlatuze region the heavy industry and mining is a major contributor to GDP with a value of R67 533.75 million. Light industry also contributes significantly with a value of R6 685.73 million.

Low-income households benefit most from heavy industry and mining with a value of R23 568.27 million followed by light industry with a value of R2 279.84 million.

When taking into account the current water use to the sectors, sugar milling, tourism and mining are significant in the Lower Mhlatuze catchment in terms of per unit of water used/allocated. The two sectors also employ more people per unit of water used/allocated (see **Table 4.18** below). The primary sectors of agriculture and forestry do not contribute significantly based on per unit of water use/allocated for production in the sector. However they are important for the downstream secondary sectors.

Commercial forestry and the related saw mills also contribute to the GDP and employment but on a limited scale. Therefore, if curtailment is required to provide water to meet the ecological water requirements in this economic zone, the recommendation is that curtailment will need to be done to commercial forestry as well as agriculture first before other sectors are considered. However this will have a knock-on effect on the secondary sectors dependent on the primary sectors. Tourism is significant in the catchment and will benefit from improving the ecosystem functioning in the catchment. There is significant eco-tourism in the Lower Mhlatuze catchment.

Table 4.18: Comparison of the sector for each unit of water used/allocated – Lower Mhlatuze

Parameters	Agriculture	Forestry	Sawmills	Heavy Industries & Mining	Sugar Mills	Tourism
Gross Domestic Product (R million)	88.28	296.53	153.53	67533.75	913.02	507.66
Water use (million m3/a)	15.44	20.50	0.18	94.87	2	0.098
GDP per m3 of water used	5.72	14.47	852.94	711.86	456.51	5,180.20
Total employed	1135	2,212.00	1317	290966	4598	4102
Water use	15.44	20.50	0.18	94.87	2.00	0.10
Households per million m3 of water used	74.00	108.00	7,317.00	3,067.00	2,299.00	41,857.00
Low Income Households	25.87	63.57	53.9	23568.27	312.66	146.87
Water use	15.44	20.50	0.18	94.87	2.00	0.10
Income to low income households per million m3 of water used	2.00	3.00	299.00	248.00	156.00	1,499.00

4.5.11 Matigulu / Mhlazi economic zone

The following table and graphs presents a picture of the current contribution of the large water users to the economy of the Matigulu / Mhlazi economic zone.

Table 4.19: Macro-Economic parameters of the Matigulu / Mhlazi economic zone (2012 prices)

		Forestry	Saw Mills	Tourism	ER10 Total
GDP (Rand Million)	Direct Impact	R 22.85	R 11.11	R 234.51	**R 268.48**
	Indirect and induced impact	R 17.91	R 12.21	R 206.56	**R 236.68**
	Total Impact	R 40.76	R 23.33	R 441.07	R 505.16
Labour (Numbers)	Direct Impact	190	103	1948	**2241**
	Indirect and induced impact	169	97	1616	**1882**
	Total Impact	359	200	3564	4123
Low-income households (Rand Million)	Direct Impact	R 2.92	R 2.64	R 35.41	**R 40.97**
	Indirect and induced impact	R 8.45	R 5.55	R 92.19	**R 106.20**
	Total Impact	R 11.37	R 8.19	R 127.61	R 147.17
Total households (Rand Million)	Direct Impact	R 9.37	R 4.34	R 80.58	**R 94.29**
	Indirect and induced impact	R 32.98	R 21.78	R 361.42	**R 416.18**
	Total Impact	R 42.35	R 26.12	R 442.00	R 510.47

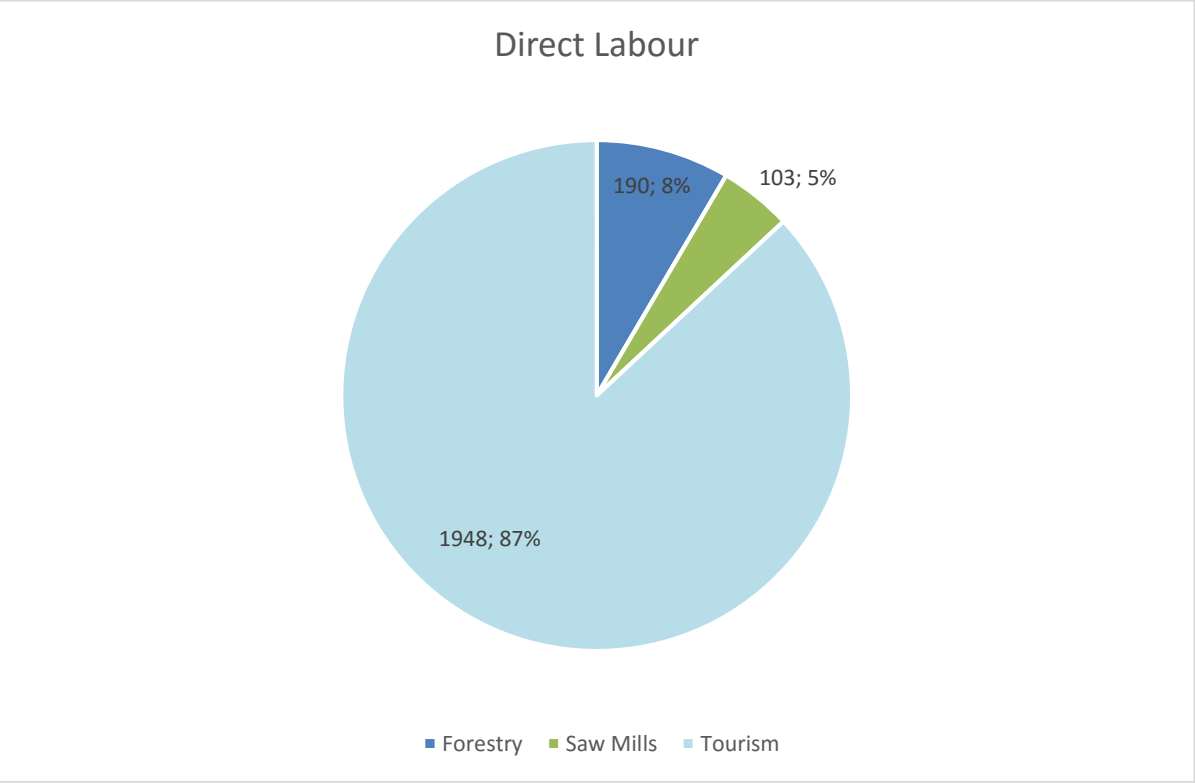


Figure 4:22: Composition of direct labour in the Matigulu / Mlazi economic zone

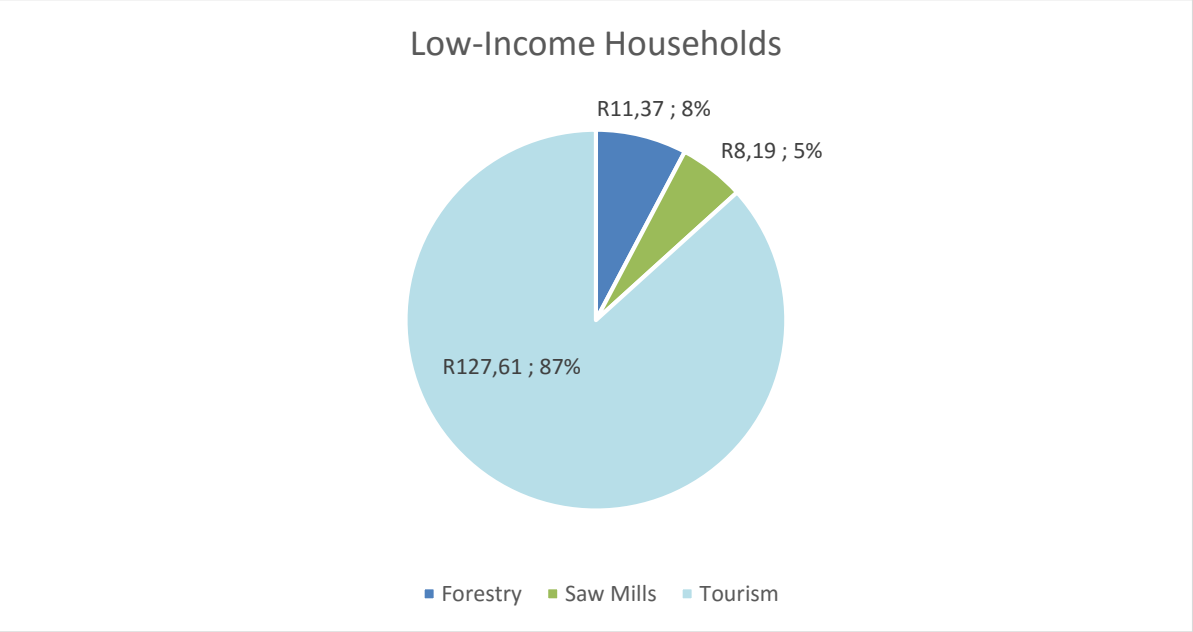


Figure 4:23: Composition of low income households in the Matigulu / Mhlazi economic zone

The industry which contributes the most to GDP is tourism with a value of R441.07 Million.

Tourism also provides the most jobs at 1 948 direct and 1 616 indirect jobs for a total of 3 564 jobs.

Low-income households also benefit the most from tourism with a value of R127.61 Million.

4.5.12 Kosi Bay economic zone

The following table and graphs presents a picture of the current contribution of the large water users to the economy of the Kosi Bay economic zone.

Table 4.20: Macro-Economic parameters of the Kosi Bay economic zone (2012 prices)

		Forestry	Saw Mills	Tourism	ER11 Total
GDP (Rand Million)	Direct Impact	R 117.76	R 57.26	R 265.45	**R 440.47**
	Indirect and induced impact	R 92.28	R 62.93	R 233.81	**R 389.02**
	Total Impact	R 210.04	R 120.19	R 499.26	R 829.50
Labour (Numbers)	Direct Impact	978	530	2206	**3714**
	Indirect and induced impact	870	501	1829	**3200**
	Total Impact	1848	1031	4034	6913
Low-income households (Rand Million)	Direct Impact	R 15.05	R 13.58	R 40.09	**R 68.72**
	Indirect and induced impact	R 43.56	R 28.61	R 104.35	**R 176.52**
	Total Impact	R 58.60	R 42.20	R 144.44	R 245.24
Total households (Rand Million)	Direct Impact	R 48.28	R 22.36	R 91.21	**R 161.85**
	Indirect and induced impact	R 169.93	R 112.22	R 409.10	**R 691.25**
	Total Impact	R 218.21	R 134.58	R 500.31	R 853.10

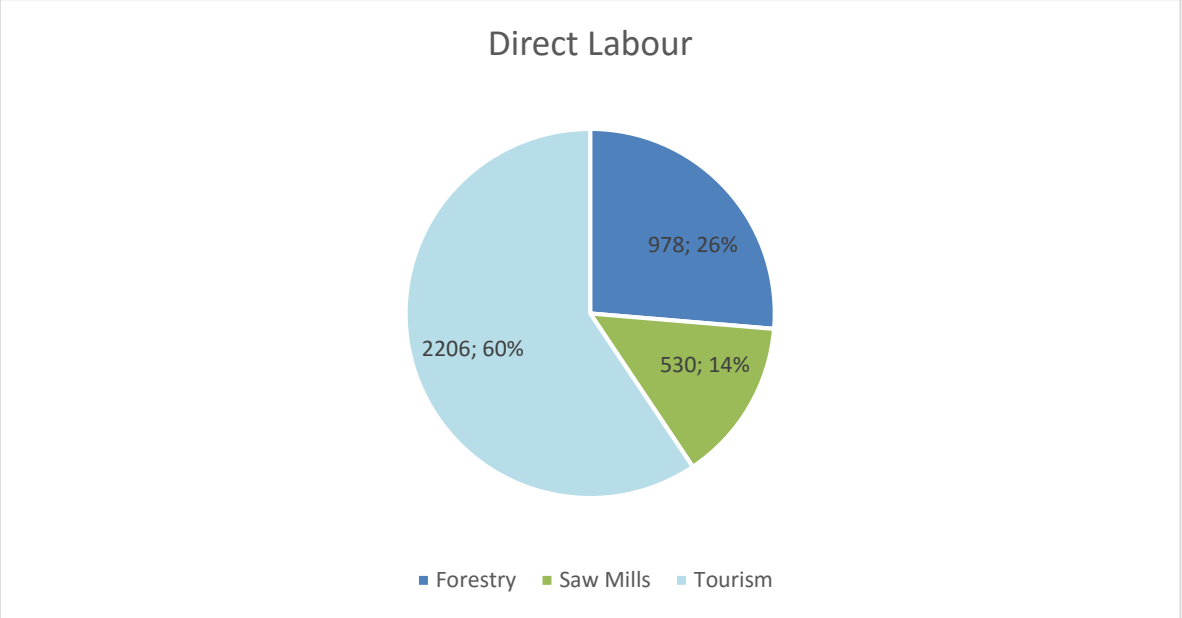


Figure 4:24: Composition of direct labour in the Kosi Bay economic zone

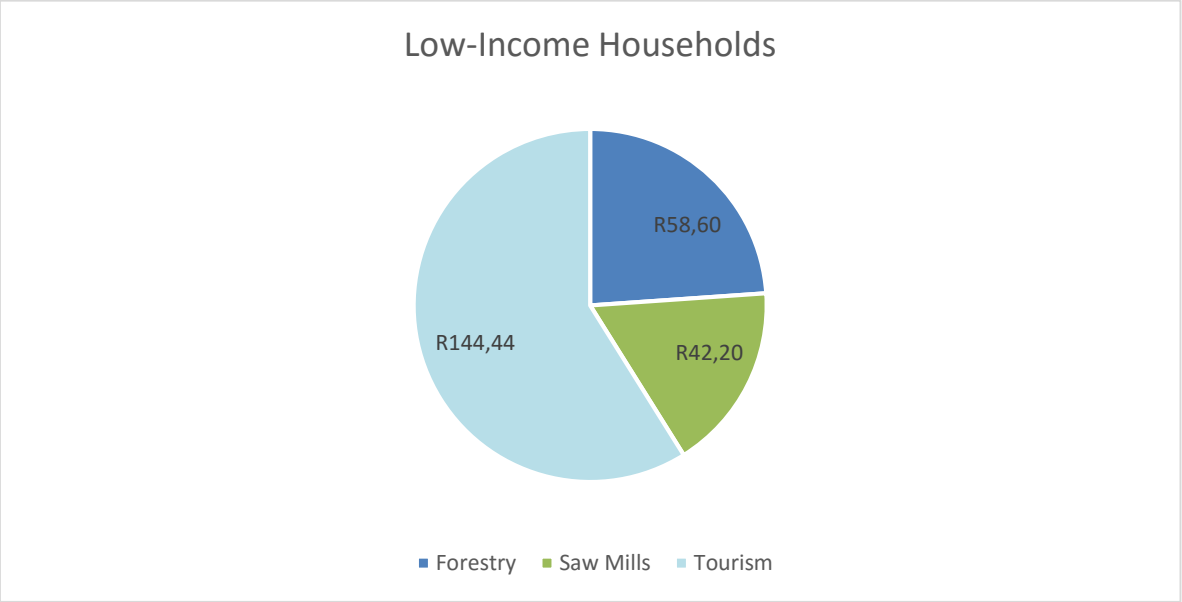


Figure 4:25: Composition of low income households in the Kosi Bay economic zone

The industry which contributes the most to GDP is tourism with a value of R499.26 million.

Tourism also provides the most jobs at 2 206 direct, 60% and 1 829 indirect jobs for a total of 4 034 jobs.

Low-income households also benefit the most from tourism with a value of R144.44 million.

4.5.13 St. Lucia economic zone

The following table and graphs presents a picture of the current contribution of the large water users to the economy of the St. Lucia economic zone.

Table 4.21: Macro-Economic parameters of the St. Lucia economic zone (2012 prices)

		Forestry	Saw Mills	Tourism	ER4 Total
GDP (Rand Million)	Direct Impact	R 83.67	R 40.69	R 1 141.17	**R 1 265.53**
	Indirect and induced impact	R 65.57	R 44.71	R 1 005.16	**R 1 115.45**
	Total Impact	R 149.24	R 85.40	R 2 146.34	R 2 380.98
Labour (Numbers)	Direct Impact	695	377	9482	**10553**
	Indirect and induced impact	618	356	7862	**8836**
	Total Impact	1313	732	17344	19390
Low-income households (Rand Million)	Direct Impact	R 10.69	R 9.65	R 172.33	**R 192.67**
	Indirect and induced impact	R 30.95	R 20.33	R 448.62	**R 499.90**
	Total Impact	R 41.64	R 29.98	R 620.95	R 692.57
Total households (Rand Million)	Direct Impact	R 34.30	R 15.89	R 392.13	**R 442.32**
	Indirect and induced impact	R 120.74	R 79.74	R 1 758.75	**R 1 959.22**
	Total Impact	R 155.04	R 95.62	R 2 150.87	R 2 401.54

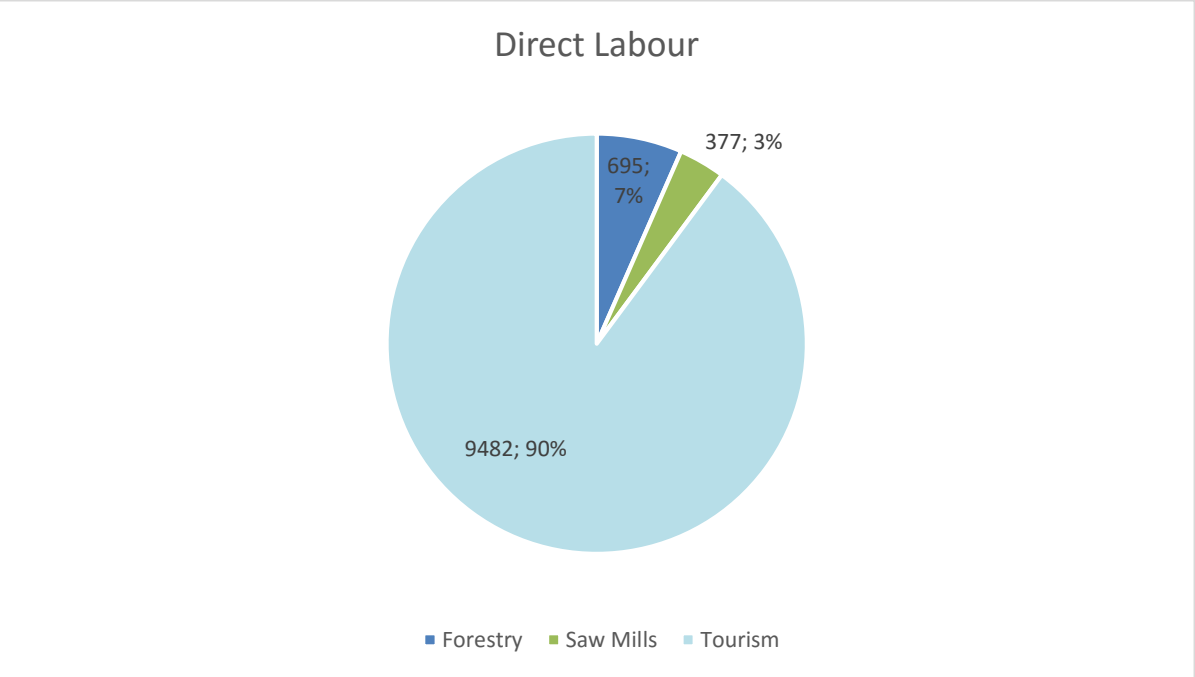


Figure 4:26: Composition of direct labour in the St. Lucia economic zone

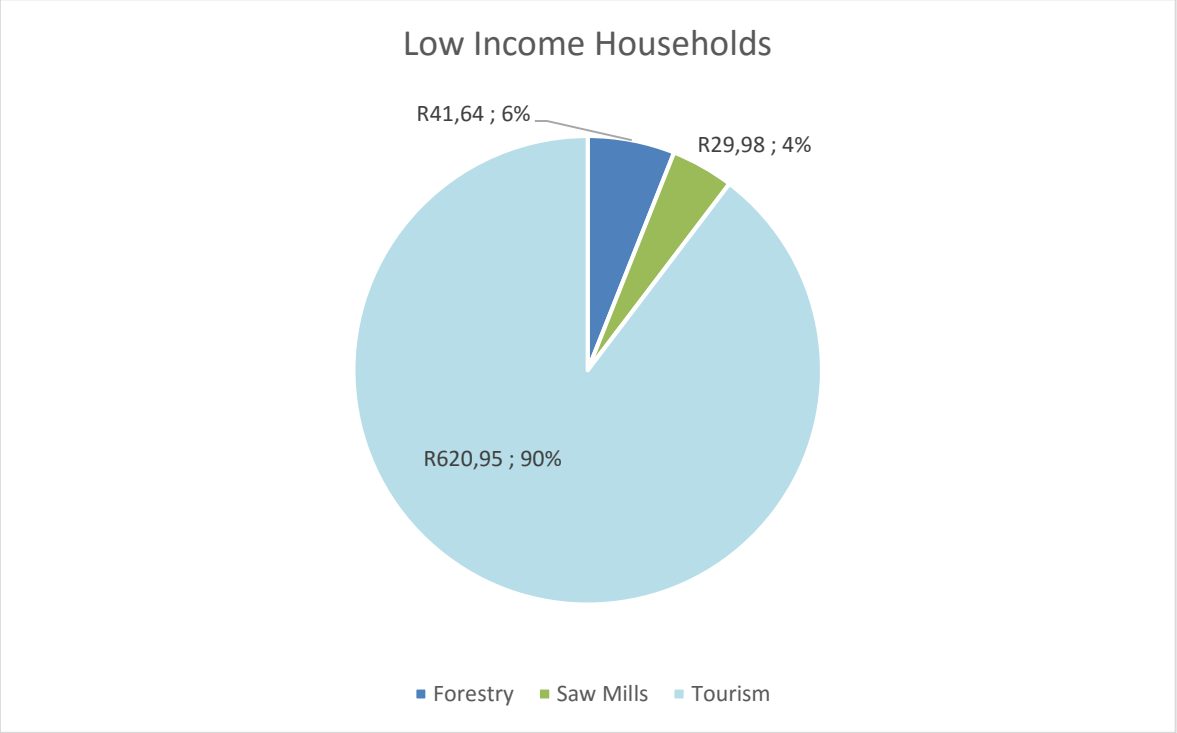


Figure 4:27: Composition of low income households in the St. Lucia economic zone

The industry which contributes the most to GDP is tourism with a value of R2 146.34 million.

Tourism also provides the most jobs at 9 482 direct and 7 862 indirect jobs, 90% for a total of 17 344 jobs.

Low-income households also benefit the most from tourism with a value of R620.95 million.

4.5.14 Hluhluwe economic zone

The following table and graphs presents a picture of the current contribution of the large water users to the economy of the Hluhluwe economic zone.

Table 4.22: Macro-Economic parameters of the Hluhluwe economic zone (2012 prices)

		Agriculture	Forestry	Saw Mills	Tourism	ER13 Total
GDP (Rand Million)	Direct Impact	R 29.21	R 92.24	R 44.85	R 375.15	**R 541.46**
	Indirect and induced impact	R 44.98	R 72.29	R 49.29	R 330.44	**R 497.00**
	Total Impact	R 74.20	R 164.53	R 94.15	R 705.58	R 1 038.46
Labour (Numbers)	Direct Impact	431	766	415	3117	**4729.1**
	Indirect and induced impact	361	682	392	2585	**4019.6**
	Total Impact	792	1448	807	5702	8748.8
Low-income households (Rand Million)	Direct Impact	R 2.60	R 11.79	R 10.64	R 56.65	**R 81.68**
	Indirect and induced impact	R 20.87	R 34.12	R 22.41	R 147.48	**R 224.88**
	Total Impact	R 23.47	R 45.90	R 33.05	R 204.13	R 306.56
Total households (Rand Million)	Direct Impact	R 5.79	R 37.82	R 17.51	R 128.91	**R 190.03**
	Indirect and induced impact	R 81.51	R 133.11	R 87.90	R 578.17	**R 880.69**
	Total Impact	R 87.31	R 170.92	R 105.42	R 707.07	R 1 070.72

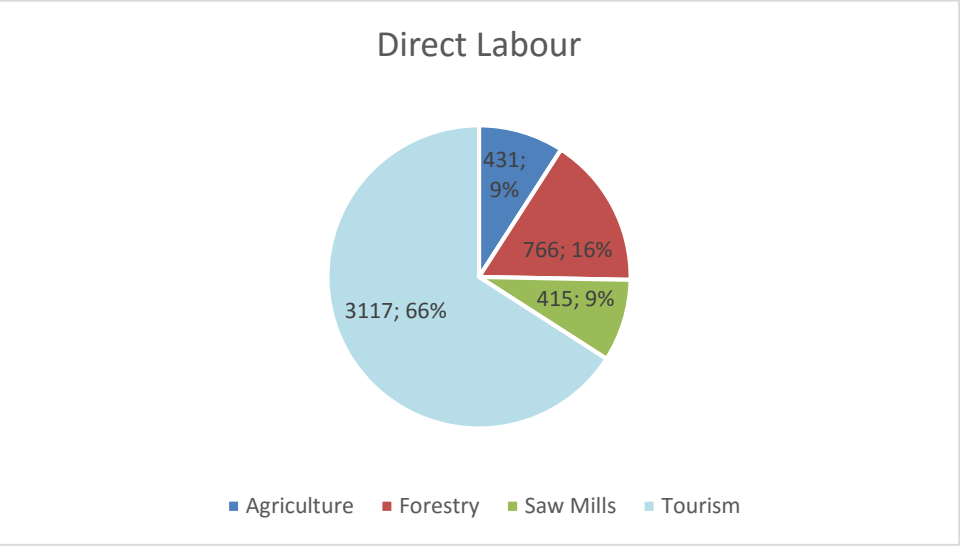


Figure 4:28: Composition of direct labour in the Hluhluwe economic zone

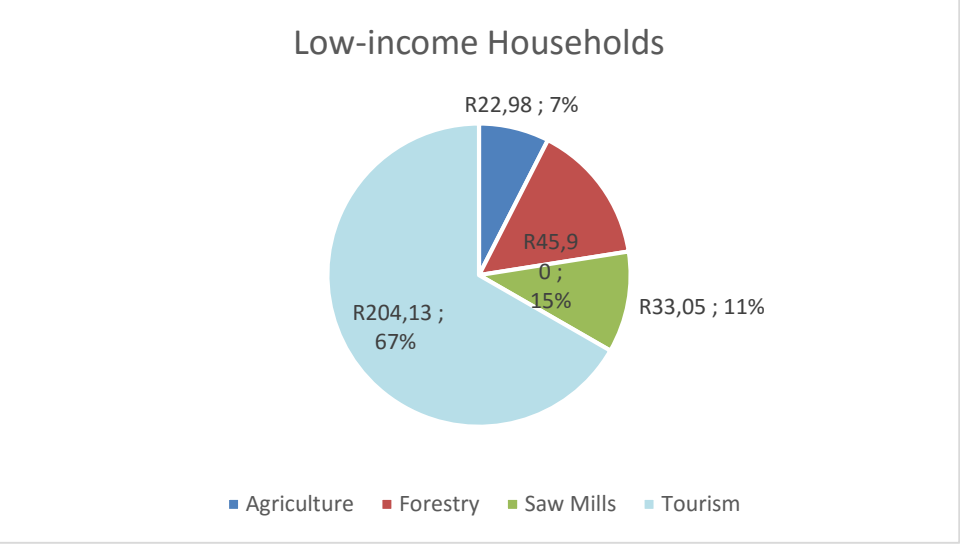


Figure 4:29: Composition of low income households in the Hluhluwe economic zone

The industry which contributes the most to GDP is tourism with a value of R705.58 million.

Tourism also provides the most jobs at 3 117 direct, 66% and 2 585 indirect jobs for a total of 5 702 jobs.

Low-income households also benefit the most from tourism with a value of R204.13 million.

5 ECOLOGICAL GOODS AND SERVICES

5.1 Overview

In determining the economic value of ecological water in each of the socio-economic zone of the Usutu-Mhlathuze Catchment, the following ecological goods and services have been analysed:

- Flood plain agriculture particularly in the Lower Pongolapoort River
- Fishing (food processing)
- Thatch grass
- Reeds
- Recreational fishing
- Recreational boating
- Recreational swimming
- Waste accumulation
- Waste dilution
- Cultivated floodplains
- Sand mining, and
- Goods and services from estuaries and wetlands with a focus on the Kosi Bay system.

5.2 How ecosystem services are supplied

Communities particularly the low income households use river systems and estuary services for either economic or social benefits. These services are generated by the processes within river systems and between rivers and estuaries and associated, freshwater and land ecosystems. The quantity and quality of the services supplied are largely a result of the size and condition of the estuary habitats.

It is important to note that one of the most significant input factors of ecosystem services production is the water supply cycle. The bigger and more pristine the river systems and estuaries, the greater range, quality and levels of services will be supplied. The habitat conditions are a result of large landscape levels processes, such as the upstream water cycle, the topographic processes and importantly the outputs of human activities. These processes in combination determine how well the rivers and estuaries as factories of ecosystem production will work, repair itself and adapt to changes.

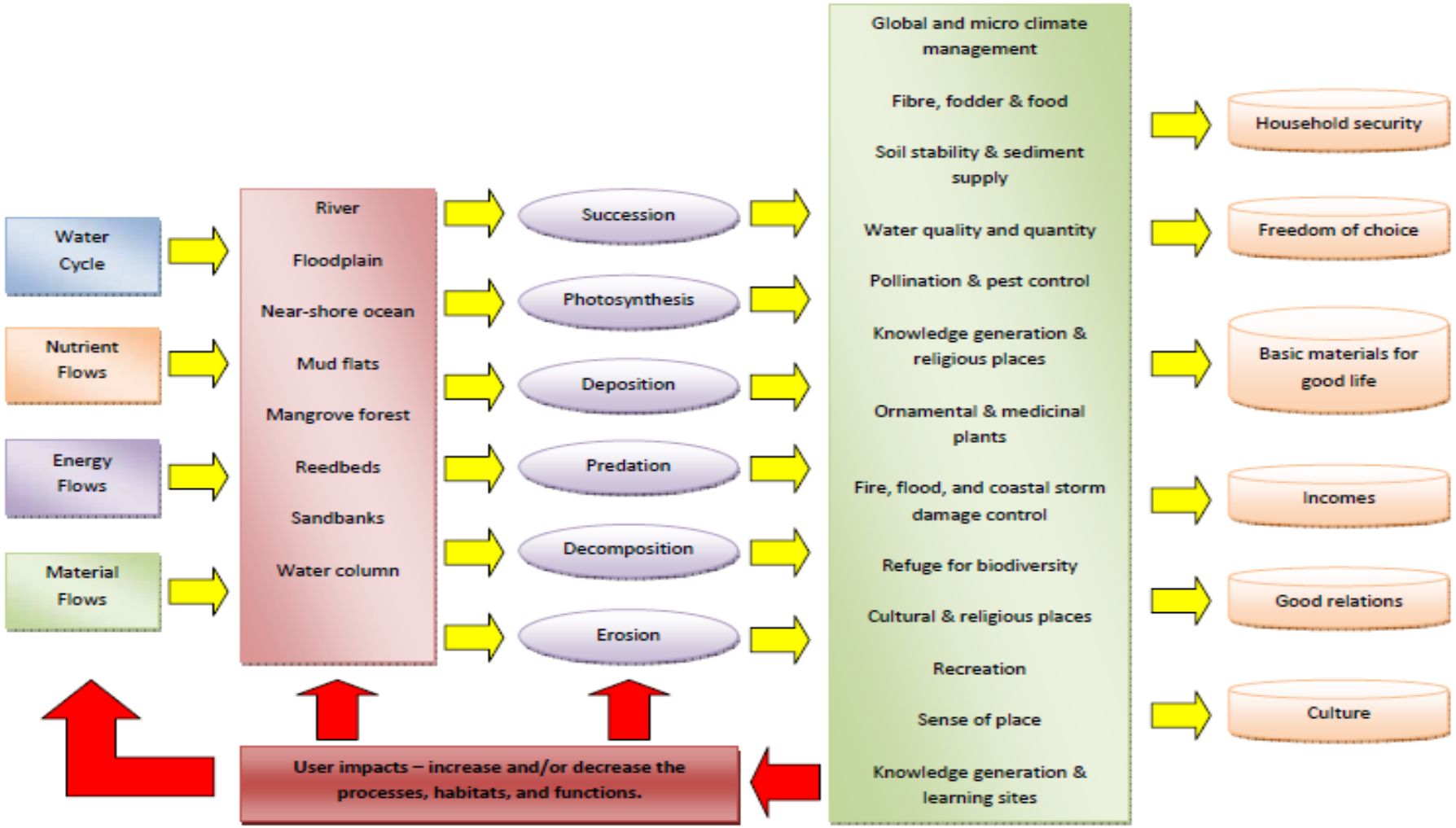


Figure 5:1: Process diagram showing how ecosystem services are supplied

5.3 Objectives of assessing the status of the ecological services

The primary objectives of the study on the status of the ecological services has been summarised as follows:

(i). To describe the types of services delivered by aquatic ecosystems in the Usuthu to Mhlathuze catchments with particular focus on the Pongola Floodplains and their relationship to ecosystem characteristics and health;

(ii). To describe the qualitative and quantitative value and distribution of benefits derived from different services (e.g. to local and other communities) and the relationship of value to socio-economic context of the Usuthu to Mhlathuze catchments as well as ecosystem characteristics;

(iii). To describe spatial variations in the delivery and value of ecosystem services in the study area; and

(iv). To rate the probable economic significance of all the aquatic ecosystems (river reaches, wetlands and estuaries) in the study area and identify critical areas for current and potential resource use.

5.4 Overview of the aquatic ecosystems in the Usutu to Mhlathuze catchments

The main areas associated with the aquatic systems in the catchments ca ne summarised as follows:

5.4.1 Overview of the Pongola River system

The Pongola River flows through Ithala Game Reserve upstream of the Pongolopoort Dam while the Pongola Nature Reserve is located on the shores of the dam. The Pongola Floodplains are located downstream of the dam and contains pans including the Ndumo Game Reserve at the border with Mozambique.

The pans of this flood plain depend on the Pongola River and are very important to the communities in the catchment.

Besides the Pongola Floodplains there is the Kosi Bay which is located to the north-eastern corner of the Pongola River system. The system is composed of four interconnected, roughly circular lakes (Makhawulani, Mpungwini, Nhlange and aManzimnyama), a broad channel leading to an estuary, which opens to the Indian Ocean and three extensive areas of swamp. The lakes are separated from the ocean by a strip of forested sand dunes 600 - 2000 m in width.

The Kosi Bay system plays a critical role in sustaining the social and economic welfare of the local communities. This is because of the natural goods and services that the system provides in terms of food production, tourism as well as waste dilution.

5.4.2 Overview of the Lake St Lucia system

There are large swamps where the Mkuze River enters Lake St. Lucia, which is a World Heritage Site. The eastern shores of Lake St. Lucia are a game reserve. Water from the Mkuze River is essential to maintain the salinity levels in Lake St. Lucia. The Mkuze Game Reserve lies upstream with the Mkuze River forming the western border of the reserve. Both the Black and White Mfolozi Rivers flow through the Hluhluwe and Imfolozi Game Reserves, with their confluence within the reserve complex. The Opathe Game Reserve is situated on the southern banks of the White Mfolozi River – this reserve is part of the Emakhosini Opathe Heritage Park near Ulundi.

The above two areas are the focus of this study. Other areas of conservation importance within the catchments are small, and may have high conservation value, such as two small cycad reserves.

5.5 Valuation of the ecological goods and services – Lower Pongola Economic zone

5.5.1 Existing goods and services identified

5.5.1.1 Floodplain agriculture

There are many households on the Pongola floodplain involved in small-scale, mainly subsistence agriculture, which are reliant on the water from the Pongola River for irrigation and soil moisture. Nutrients and sediments are carried down in flood events to replenish the soil fertility between the pans and the Pongola River. These households derive value from agriculture either directly through sales (on local market and / or to neighbours), or indirectly through household consumption.

The crops most widely cultivated on the floodplain by local households to supplement household food security are; maize; sweet potato; pumpkins and butternuts; beans and groundnuts.

Figure 5.1 and **Table 5.1** below provide an assessment of the major pans where floodplain agriculture is taking place. The floodplain agriculture benefits approximately 6 249 households or 35 000 people directly, while an additional 5 000 households are indirectly dependent on the sale of the agricultural products from the plains.

The timing of flood releases from the Jozini Dam has significant implication on the level of production. The farmers typically wait for the August or September flood release from the Jozini Dam to flood their fields on the floodplain before they start preparing for planting. The most important planting season is September with most harvesting taking place from March the next year. Therefore flood releases between September and July would flood the crops in the floodplain and result in partial or total crop failure.

5.5.1.2 Natural resource harvesting

Approximately 72% of the households or 4 500 households in the floodplain regularly utilize natural resources from the floodplain. The resources most widely harvested by local households include, (1)

Fish from river and pans (60%); (ii) Reeds (Phragmites sp) (28%); (iii) Thatching grass (Cyperus sp) (16%); (iv) Bulrushes (Typha sp) (12%); (v) Wild figs (Ficus sp) (12%) and (vi) Water lilies (Nymphae sp) (8%).

However, the most commonly harvested natural goods and services are fish and reeds. Less than half of the household catch fish every week for mainly semi-commercial basis in order to earn an income. Some fishermen reported earning as much as R2 500 per month from the sale of fish and can be higher at the beginning of the rainy season. Studies of floodplain fisheries have found yields in the order of 37 kg per ha of floodplain. In the case of the Pongola Floodplains it was estimated that approximately 200 tonnes per year. The economic value of fishing translates to approximately R4.5 million per year in local economic contribution while benefiting approximately 6 450 households.

Table 5.1: Significant pans for floodplain agriculture

Pan	Flood plain Area (ha)	Areas being cultivated	Households dependent on agriculture
Mzinyoni	81.2		462
Mthikeni / Subane	102.92		537
Tete / Tetekanye	131.8		708
Mengu	28.5		381
Shalala	46.1		578
Sokhunti	96		906
Mandlankunzi	194		729
Nomaneni/Ngodo/ Bumbe	143.84		1380
Khumaleni / Khangazeni / Sivunguvungu	87.1		568
			6 249

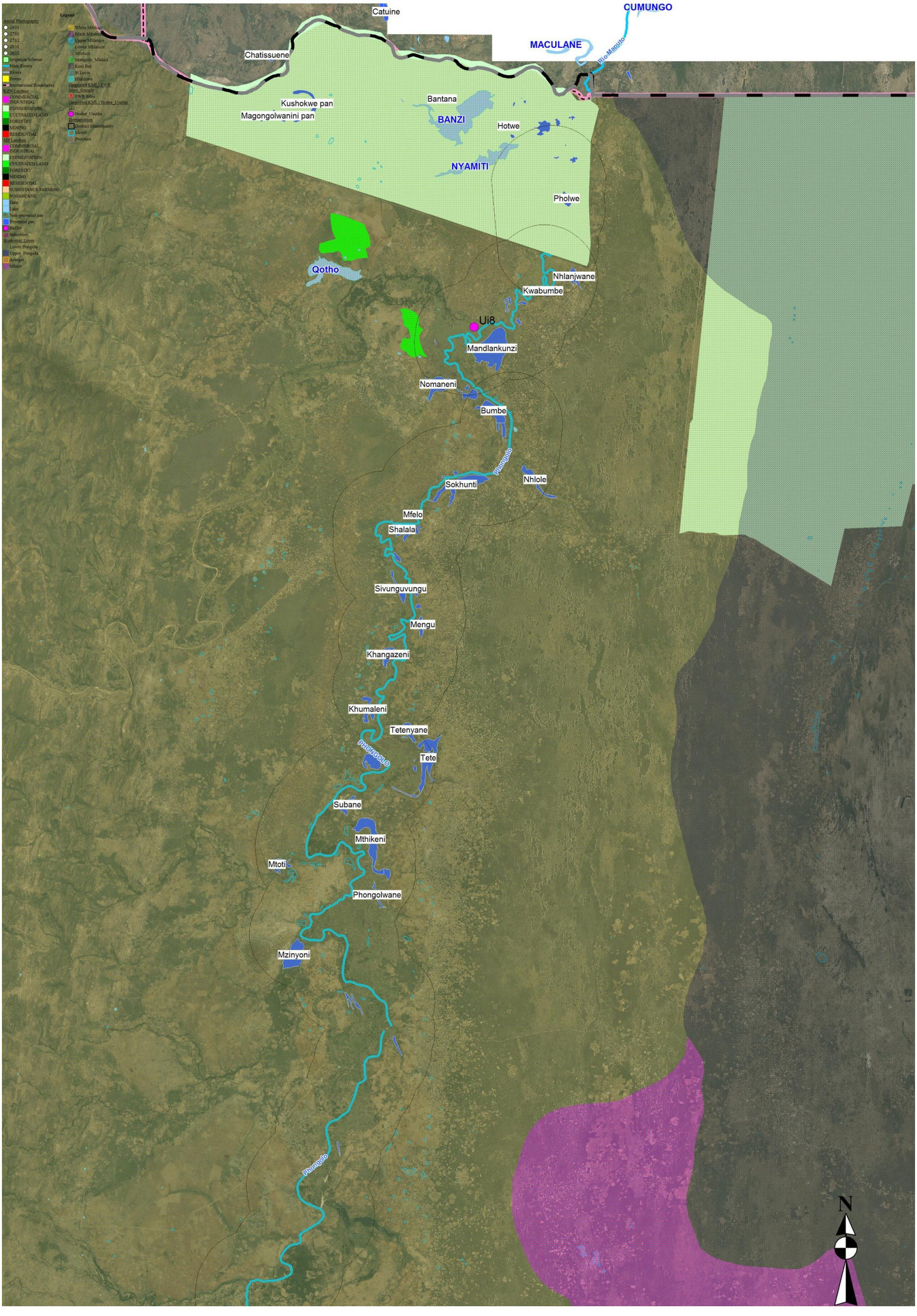


Figure 5:2: Main pans in the lower Pongola River important for floodplain agriculture

Reeds are used for building (walls and roofs) of houses and are an important alternative to corrugated iron and brick which are expensive and largely unaffordable to local households. The over-harvesting and erosion in areas around the pans where the reeds grow has reduced the quality and quantity of the reeds. This is having a significant socio-economic impact on the welfare of the communities who will depend on more expensive roofing material.

5.5.1.3 Cattle grazing in the Floodplains

Besides the floodplain agriculture and harvesting of the natural resources, the floodplains provide grazing areas for cattle. This benefits the local economic as it provides significant value to the local economy.

5.5.2 Valuation of the floodplain goods and services

Subsistence cultivation in riverine areas in the Pongola Floodplain has had a significant social and economic benefit to the local communities as is illustrated in **Table 5.2** below. In addition to the value add subsistence cultivation can be viewed as compatible with the preservation of riverine vegetation and other floodplain ecological considerations.

The most significant value added to the local economy has been the floodplain agricultural activity which is generating revenue as much as nearly R1.2 billion in revenue in the area. This includes commercial floodplain agriculture that is also taking place in the area. The most significant area is between the Pongola River and the pans.

Fishing is the second most important economic activity of the Pongola floodplains.

5.5.3 Changes in the goods and services in future

Changes in the goods and service to the communities downstream of Jozini Dam have been identified as follows:

- *Supporting Services*: There have been losses in the nutrients and silt downstream of the dam. The direct loss of annual silt and nutrient replenishment as a result of the Dam is believed to have contributed to loss of fertility of previously productive floodplain soils.
- *Regulating* - The availability of water is now regulated by the Dam, has had a positive impact on the ability of the system to control disease.
- *Provisioning:* The spawning of several species of fish is entirely dependent on flooding of the system. Changes in the timing of floods as a result of the dam coupled with over-fishing, has resulted in a decrease in fish stocks and consequent loss of this food resource.
- *Cultural:* Traditional practices such as communal fishing drives, which are important community building activities, have decreased as a result of changes in the timing of floods and reduction in flows which have, together with over-fishing, resulted in a deterioration of fish stocks.

Table 5.2: Valuation of the goods and services derived from the Pongola Floodplain

Land uses in the basin and on the floodplain	Return on land use per hectare per year (incomes or non-market use values)	Return on land use per year (incomes or non-market use values)	Gross margin ha/yr (incomes less costs)	Return per m3/yr used	Numbers of beneficiaries - households	Numbers of beneficiaries - individuals
Floodplain agriculture - rain fed mixed crops	R7,358.18	R95,560,626.00	R3,175.90	R0.32	12,987.00	77,922.00
Floodplain natural products harvesting - plants and fish	R2,273.21	R49,569,691.00	R1,231.56	R0.17	12,987.00	77,922.00
Floodplain cattle	R620.90	R3,539,445.00	R461.75	R0.05	3,896.00	23,377.00
Pongola floodplain Values	R10,252.00	R158,669,762.00	R4,869.21	R0.53	29,870	
Natural resource use combined	R 2,894.00	R63,109,136.00	R1,693.00	R0.21	12,987	
Household benefits from the floodplain		R11,447.58				

5.6 Valuation of the ecological goods and services - Kosi Bay system

5.6.1 Existing goods and services identified

5.6.1.1 Fishing

The Kosi estuary is considered to fulfil an important nursery function and it is said that “many thousands” of juvenile fish mature here before migrating to the sea. The latest results have shown that 133 species of fish occurred within the Kosi system, comprising 86 marine species, which were found in association with the reef at the mouth or penetrated the tidal basin, 39 species of resident estuarine fish, which penetrated the system to beyond the tidal basin and 9 freshwater species

There are a number of fish, crustacean, and mollusc species which make the Kosi Bay system their home and in turn provide an important source of food for both commercial and subsistence harvesters.

The communities surrounding the Kosi Bay use traditional fish kraals or traps to harvest fish in the Kosi Bay estuary system, providing an important source of protein and a major tourist attraction.

Food harvested from estuaries are either consumed at home or traded as far as Durban to generate some income for the household. It is estimated that approximately 200 tonnes per year of fish are caught. This is generating approximately R4,8 million per year for the region alone either directly or indirectly.

Figure 5:3: Fish Kraal in Lake 2

5.6.1.2 Building material

The vegetation, such as mangroves trees, sedges and reeds, which grow in and around estuaries provide an important source of poles and fibres used in household construction, particularly for low-income households.

The reeds such as *Phragmites australis* are commonly used for building the walls of huts when bricks are not available or too expensive.

The mangroves such as *Bruguiera gymnorrzia* or Black Mangrove are used for roof poles. Some households also harvest these building materials to sell for additional income.

There was no information available as the extent of the economic value of the building materials. Therefore, the replacement cost estimate was used to determine the value of the building materials Based on an average cost of roofing of R358 per m^2, with the number of housing developments taking place estimated at 654 low income houses (*2014/15 IDP Review, Umkhanyakude DM*), it was estimated that approximately R 23,478 million is generated of which a portion is dependent on building materials such mangroves.

5.6.1.3 Cattle grazing

Grazing of cattle and goats has also been reported to take place in the Kosi Bay Nature Reserve. While it was estimated that there were approximately 1 100 cattle using the reserve (Kyle 1995), no indication is given of the utilisation and importance of areas around the wetlands and estuary compared to other areas in the reserve for this grazing.

The flat and open floodplains adjacent to the Kosi Bay lakes and estuaries provide an important source of fodder for rural households. For example, the grassland areas are used for grazing stock animals, which in turn provide meat or milk for the owners. In this way, the floodplains sustain rural livelihoods and provide food security, particularly for low- income households.

5.6.1.4 Medicinal Plants

There are a number of plants which grow in and around estuaries that have medicinal properties and provide an important source of traditional medicine.

For example, the roots and stem of *Barringtonia racemosa* or the Powder-puff Tree which is common in the Kosi Bay system (*personal communication with Ricky Taylor)* are used to treat fever, stomach aches, and skin diseases. Extracts from the plant are effective insecticides and are used medicinally to also treat malaria. The seeds, bark, wood and roots contain the poison saponin and is used to stun fish.

In the absence of these medicinal plants, people will be forced to travel great distances and at a great expense to source medicines that would otherwise have been available locally.

5.6.1.5 Waste assimilation and dilution

The water quality in estuaries and the near-shore is negatively affected by the large number of wastewater treatment works, industries, and stormwater drains, which discharge wastewater into rivers. The plants, such as algae, which occur in and around estuaries, are able to take up excess nutrients (e.g. nitrates) which they need in order to grow, making the water cleaner for people to use, and for the river ecology to thrive.

This also represents a major saving for residents as the cost of constructing a similar treatment plant is avoided. The aquatic organisms, such as diatoms, which occur in estuaries, are also able to assimilate the pathogens or parasites (e.g. E.coli) which can impact negatively on the health of people. In the absence of these ecological processes, it is more likely that people will be exposed to water-borne diseases. The provision of these ecosystem services by Kosi bay system and wetlands is however limited, particularly when it is degraded. When these limits are exceeded, the estuary is unable to clean-up the wastewater effluent, creating a major health hazard and reducing the amenity value and tourism potential of the area.

6 CONCLUSION AND RECOMMENDATIONS

6.1 Overview of the macro-economic activities

According to a 2000 report by Urban Econ to DWS, (cited in DWAF 2004e), the Usutu to Mhlatuze catchments contributed 1.94% to South Africa's Gross Domestic Product (GDP) with a Gross Geographic Product (GGP) of R9.7 billion. The most important sectors and their contributions to GGP are:

- Manufacturing and mining (35.5%),
- Agriculture (15.2%),
- Transport (12.5%) and
- Other (36.8%).

The agricultural sector in the Usutu to Mhlathuze catchment is well developed and has important secondary markets which do not necessarily reflect in the use of the water resources of the catchments. The major activities are crop farming, cattle farming, game farming, sugar plantations and forestry.

The important contribution of manufacturing is attributed to the availability of agricultural and timber products, the railway infrastructure and the Richards Bay harbor. Power supply and water also contribute to the sector, while key industries are pulp and paper manufacturing and aluminum smelting. Timber and sugar are important raw materials for the industrial sector.

Tourism is a very important sector for the economic welfare of the Usutu to Mhlathuze catchments. The coastline is a popular holiday destination with attractions including Lake St. Lucia, Kosi Bay and Sodwana Bay. There are several well-known nature reserves in the area which are managed by Ezemvelo KZN Wildlife as well as a number of private game reserves in the region.

6.2 Summary of the ecosystem services

The most critical areas in the Usutu to Mhlathuze catchments regarding the ecosystem services are the Pongola floodplains, the Kosi Bay system and the Lake St Lucia system.

There are significant ecosystem goods and services generated in the Pongola Floodplain that are dependent on the timing and volume of the releases of the water from the Pongola Dam. the construction of the Pongolapoort Dam has had a significant impact on the functioning of the downstream ecosystems and the associated supply of ecosystem services.

As a result, there has been trade-off which has occurred between the reduction in the provision of ecosystem goods and services for an increase in agriculture which has been at the expense of the ecology. In the Pongola region, the decision to convert large portions of the floodplain to cultivated land and to alter flooding regimes to support food and cash crops has come at the expense of other less tangible ecosystem services.

In the short term the single sector economy (i.e. agriculture), either structured or unstructured, may appear to address the challenges of poverty alleviation by creating tangible benefits through the provisioning services. However, in the long term it could compromise the overall functioning of the ecosystem and the generation of cultural, regulating and supporting services, which holistically support the livelihoods of the poor. This will need to be effectively managed to ensure that the ecosystem goods and services which are of critical importance to the low income households do not decline significantly to the extent of significant loss of the ecosystem services.

In the case of the Kosi Bay system, the influence of multiply governance arrangement of the management of the ecosystem has not had the desired effect with the likely over-utilisation of the existing ecosystem goods and services such as fishing and other services.

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