

INTISARI

Sungai alogenik merupakan sungai yang berasal dari luar kawasan karst, namun mengimbuh airtanah di kawasan karst melalui ponor. Meskipun telah diketahui bahwa sungai alogenik telah berperan dalam mengimbuh airtanah di kawasan karst, tetapi karakteristik sistem, genesis, karakter hidrodinamika dan hidrogeokimia serta peranannya dalam karstifikasi kawasan karst belum banyak dikaji. Penelitian ini bertujuan untuk: (1) mengkarakterisasi sistem sungai alogenik yang mengimbuh airtanah Kawasan Karst Gunungsewu Kabupaten Gunungkidul dan membuat model perkembangannya, (2) mengkarakterisasi variasi spasial-temporal hidrodinamika dan hidrogeokimia sungai alogenik yang mengimbuh airtanah Kawasan Karst Gunungsewu Kabupaten Gunungkidul; dan (3) mengevaluasi peranan sistem sungai alogenik dalam proses karstifikasi di Kawasan Karst Gunungsewu Kabupaten Gunungkidul.

Analisis karakteristik sistem sungai alogenik dilakukan dengan melakukan kajian terhadap pola spasial kemunculan dan ketidakhadiran sungai alogenik, sifat aliran, morfometri DAS dan tingkat perkembangan jaringan sungai alogenik, bentuk ponor pada sungai alogenik, tipe sungai alogenik berdasarkan genesisnya, dan model perkembangan sungai alogenik di lokasi kajian. Analisis karakteristik variasi spasial-temporal hidrogeokimia dan sifat aliran dilakukan dengan pengambilan sampel air setiap dua minggu selama satu tahun, dan pemasangan alat pencatat tinggi muka air otomatis yang dipasang di lima sungai alogenik. Analisis hidrogeokimia dilakukan dengan analisis parameter fisika dan kimia khususnya unsur mayor. Analisis hidrodinamika dilakukan dengan analisis konstanta aliran dengan pemisahan aliran dasar. Kuantifikasi peranan sungai alogenik dalam proses karstifikasi didasarkan pada analisis terhadap nilai *saturation indices*, laju pelarutan, *wall retreat* dan analisis BTC hasil penerapan *artificial tracer test*.

Hasil analisis menunjukkan bahwa sungai alogenik di Kawasan Karst Gunungsewu sejumlah 18 sungai alogenik yang tersebar di Subsistem Hidrogeologi Ponjong dan Subsistem Hidrogeologi Wonosari-Baron. Secara genesis pembentukan sungai alogenik di Subsistem Hidrogeologi Ponjong adalah *allogenic from underlying beds exposed updip*, sedangkan pada Subsistem Hidrogeologi Wonosari-Baron berkembang tipe kombinasi *allogenic from overlying beds* dan tipe *across a faulted contact with pervious rocks* dengan kombinasi keberadaan patahan. Penelitian ini membuat model perkembangan sungai alogenik di Subsistem Hidrogeologi Ponjong yang terdiri atas empat tahap, dan di Subsistem Hidrogeologi Wonosari-Baron yang terdiri atas enam tahap. Analisis hidrodinamika dan hidrogeokimia menunjukkan keterkaitan keduanya dalam proses yang dominan terjadi di lokasi kajian seperti *dilution by precipitation*, *mixing*, *water-rock interaction* dan *reverse ion exchange*. Penelitian ini juga menunjukkan bahwa sungai alogenik memiliki masa agresif pada awal musim penghujan karena *flushing effect*, produktivitas karbondioksida yang tinggi di dalam tanah dan keberadaan hujan yang menyebabkan terjadinya *dilution by precipitation*. Penelitian juga menunjukkan bahwa sungai alogenik telah berperan dalam karstifikasi, di mana mataair dengan imbuhan alogenik memiliki laju denudasi sebesar $92,69 \text{ m}^3/\text{km}^2/\text{tahun}$ yang lebih besar dari sungai bawah tanah tetapi lebih rendah dibandingkan dengan mataair epikarst. Penelitian juga menunjukkan peranan sungai alogenik dalam pembentukan tipe lorong *single conduit* di lokasi kajian.

Kata Kunci: Sungai Alogenik, Model Perkembangan Sungai Alogenik, Hidrodinamika, Hidrokimia, Karstifikasi

ABSTRACT

Allogenic rivers are rivers that originate from outside the karst area, but recharge groundwater in the karst area through ponors. Although it is known that allogenic rivers have played a role in recharging groundwater in karst areas, the system characteristics, genesis, hydrodynamic and hydrogeochemical characteristics and their role in karstification of karst areas have not been widely studied. This study aims to: (1) characterize allogenic river systems that recharge groundwater in the Gunungsewu Karst Area of Gunungkidul Regency and model their development, (2) characterize spatial-temporal variations in hydrogeochemistry and flow properties in allogenic rivers that recharge groundwater in the Gunungsewu Karst Area of Gunungkidul Regency; and (3) evaluate the role of allogenic river systems in the karstification process in the Gunungsewu Karst Area of Gunungkidul Regency.

Analysis of the characteristics of the allogenic river system was carried out by studying the spatial patterns of occurrence and non-occurrence of allogenic rivers, flow properties, watershed morphometry and the level of development of the allogenic river network, the shape of the ponor on the allogenic river, the type of allogenic river based on its genesis, and the development model of the allogenic river at the study area. Analysis of the characteristics of spatial-temporal variations in hydrogeochemistry and flow properties was carried out by taking water samples biweekly for one year, and installing automatic water level recording devices installed in five allogenic rivers. Hydrogeochemical analysis was conducted by analyzing physical and chemical parameters, especially major ions. Hydrodynamic analysis was conducted by analyzing flow constants with base flow separation. Quantification of the role of allogenic rivers in the karstification process is based on the analysis of saturation indices values, dissolution rates, wall retreat and BTCs analysis from the application of artificial tracer tests.

The results of the analysis show that there are 18 allogenic rivers in the Gunungsewu Karst Area spread across the Ponjong Hydrogeological Subsystem and Wonosari-Baron Hydrogeological Subsystem. The genesis of allogenic river formation in Ponjong Hydrogeological Subsystem is allogenic from underlying beds exposed updip, while in Wonosari-Baron Hydrogeological Subsystem allogenic from overlying beds type and allogenic from overlying beds type with a combination of faults. This study modeled allogenic river development in the Ponjong Hydrogeologic Subsystem consisting of four stages, and in the Wonosari-Baron Hydrogeologic Subsystem consisting of six stages. Analysis of hydrodynamics and hydrogeochemistry shows their interrelationship in the dominant processes occurring at the study site such as dilution by precipitation, mixing, water-rock interaction and reserve ion exchange. This study also shows that allogenic rivers have an aggressive period at the beginning of the rainy season due to the flushing effect, high carbon dioxide productivity in the soil and the presence of rain that causes dilution by precipitation. The study also showed that allogenic rivers have played a role in karstification, where allogenic recharge springs have a denudation rate of 92.69 m³/km²/year which is greater than underground rivers but lower than epikarst springs. The study also showed the role of allogenic rivers in the formation of single conduit type passages at the study site.

Keywords: Allogenic River, Allogenic River Development Model, Hydrodynamics, Hydrochemistry, Karstification