

STUDIES OF ANTHROPOGENIC LANDFORM TRANSFORMATION IN JAPAN : A PERSPECTIVE

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Abstract In Japanese geography, the explicit perception of man as an important geomorphological agent dates back to 25 or more years ago. Throughout the past years various efforts have been made to study man's role in changing the land surface form and the geomorphic processes both in the past and present. The argument has been reiterated that the man-induced changes in physical environment should be considered as an important causative factor leading to natural disasters due to geomorphic accidents. In the last few years, organized studies and related symposia have brought about great progress in the twin aspects of the subject;— *i.e.* direct transformation and induced changes in geomorphic processes. Tasks for further development in this field are summarized.

1. Introduction

In Japan, human impact on the geomorphological system is great (*e.g.*, Ota and Nogami, 1979; Walker, 1981; Yoshikawa *et al.*, 1981) and nowadays man's influence upon the land surface in this country exceeds any natural process to a great degree, in terms of rate of erosion and areal extent (Kadomura, 1980, 1983). This paper intends to review the progress made in studies on anthropogenic transformation of physical environment in Japanese geography and related sciences in the past three decades, taking note of those dealing with landform modification and associated environmental effects. Mention is also made of the problems and tasks for further research in this field.

2. Trends in Previous Studies

Table 1 has been prepared so as to give an overall view of the changes in the perception of man's role in changing the physical environment and related environmental problems in Japanese geography and neighbouring sciences in the past 30 years. Major symposia and selected publications dealing with the subjects closely connected with the present paper are listed in this table. Due to the limitation of space, some important works which appeared separately in periodicals are not included in the table. However, this table enables us to

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outline the general trends of the past studies.

As understood from Table 1, in Japan, the perception of man as an important geomorphological agent is not a recent one but dates back to 25 or more years ago. It was F. Tada (1958) who first advocated explicitly the importance of human forces in geomorphological development, giving examples of effects of riparian work, dam construction and gravel mining on river bed variations, sediment transport and coastal erosion. Together with research into the problems induced by land subsidence due to groundwater withdrawal (Nakano, 1963; Nakano and Matsuda, 1976), the studies of those topics have been regarded as the main stream of applied geomorphology in Japan since early times (Yatsu *et al.*, 1959; Tada, 1964; Nakano, 1967; Nishimura, ed., 1969). This tendency persisted throughout the past years. The recent book "The Landforms of Japan" written in English by Yoshikawa *et al.* (1981), which aims to introduce the characteristics of landforms and their forming processes in Japan to foreign readers also gives examples of man's influence upon the river and coastal processes and land subsidence. It should be mentioned that this is a rare geomorphology textbook in Japan which stresses the role of man in the geomorphological development.

Parallel to the prevalent attention to man's interference with river and coastal processes, Japanese geographers, in particular geomorphologists have made great efforts to study physical processes and environmental effects of natural disasters caused by such geomorphic accidents as floods, landslides, debris flows and land deformations generated by earthquakes, as exemplified by the works shown in Table 1. Since the 1950's the argument has been reiterated that the man-induced changes in natural landscape and geomorphic processes should be considered as an important causative factor leading to the occurrence of disasters (e.g., Nakano, 1983). Arguments of this kind have been intensified since the early 1960's when large-scale projects of residential development started in the hilly lands and areas of high relief around the major cities (Tamura, 1976; Kadomura, 1980).

Detailed geographical studies on landform modification due to residential development and its effects on the environment began in the late 1960's in the hill-lands around Sendai and Tama Hills, west of Tokyo (Tamura, 1976). From that time onward many case studies have been carried out in those two areas and elsewhere (Kadomura and Takeuchi, 1983; Tamura *et al.*, 1983). The problems originating from urbanization and the advancement of land exploitation have also attracted the attention of researchers of various fields; geology, Quaternary research, civil engineering, *etc.* Because of these problems, interdisciplinary symposia were held successively in the early 1970's by the related scientific bodies. This period corresponded to the beginning of Japan's environmental age, when the post-war national economic growth reached its culmination with ongoing widespread deterioration of physical environment. Thus, since this period, the geographical concepts, methods and techniques in environmental studies have penetrated increasingly into Japanese civil engineering through the joint symposia, works and publications.

Another main stream in the previous works in Japanese geography has been that concerning man-made landforms and environmental deterioration in historical times, and a lot of excellent works have been published on these topics. Kusaka (1973, 1975, 1980) has been energetic in reconstructing the physical environment and its modification by man in early historical times in the Kinki district, the center of the ancient country of Japan. Chiba

(1958) has given a full account of the origin and socio-economic processes of forest deterioration in Southwest Japan since the 12th century. In the Chugoku Mountains, man-made landforms resulting from sand iron mining from weathered granitic rocks in recent historical times have been investigated in detail by Akagi (1960, 1982) and Sadakata (1982). Tamura (1976), who attempts to reconstruct the history of landform transformation in the hill-lands of Japan in relation to land use development, advocates the need of research in 'historical anthropogeomorphology', by referring to the works of Golomb and Eder (1964) and Fels (1965).

3. Recent Progress

In spite of the general prevalence of the perception of man as a most important agent in transforming the natural landscape and in environmental conservation since the early 1970's, no systematic and comprehensive studies on the topics appeared until the late 1970's-early 1980's. This is due mainly to the lack of both methodologies and materials relevant to the purposeful discussions. In addition most of the geomorphologists have shown hesitation in devoting themselves to the study of man-made landforms and/or man-induced geomorphic changes for this reason. Yet some others have felt little interest in this kind of research.

In order to make up for this deficiency and to promote related studies, an organized research on "Nation-Wide Comparative Study on Large-Scale Land Transformation and Related Environmental Problems in Japan" was carried out during 1979-1981 in collaboration with 20 geographers including human geographers from many parts of the country, and the results were published in 1981 (Kadomura, ed., 1981). In addition, with a view to facilitating the research, a Working Group on Man-Made Landforms and Land Transformation was established in 1980 in the Association of Japanese Geographers (AJG) and continued its activities until the end of March 1983. The purposes of these activities were to accelerate regional case studies and to prepare national inventories showing the recent drastic landform modification due to agricultural, urban and recreational land development. Different from the previous studies which placed the emphasis on induced changes in geomorphic processes, much effort was devoted to study of the manner, areal extent and the magnitude of direct transformation of landforms by human forces. Methodological discussion on anthropogeomorphology was also a central subject of the study.

With these organized activities for a background, a symposium on "Land Transformation and Related Environmental Changes" was held in the AJG in November 1981. Papers presented at this symposium were listed in note (10) and the major points of deliberation were summarized in column for AJG, 1981 (S12). Out of 10 papers, 4 selected papers were published in fullscale together with a subject review article in the special issue on "Landform Transformation" *Geographical Review of Japan*, 56 (4), 1983 (see (14) in Table 1). Prior to this publication, in September 1982, most of the results of the group activities, including those presented at the symposium, appeared in the special volume of *Geography (Chiri)*, a monthly journal aiming at promoting the spread of geography, with two invited papers dealing with pasture reclamation in Hokkaido and an extraordinarily

large-scale land reclamation project in Kobe City, "Hills go to the Sea" project (see note (13)). The landform transformation processes in the latter project are described in detail by Tanaka *et al.* (1983).

Thanks to these activities, it is now possible to outline (1) the actual state of landform transformation processes which are presently taking place over our land, and (2) the nature and the nationwide distribution of affected areas with the magnitude of modification in terms of the depths of removed or disturbed earth material (Tamura *et al.*, 1983, Kadomura, 1983). It is also worthy of note that the concepts and methods used for the investigation of primary man-made landforms, the direct result of technological work, which are long neglected problems in Japanese geomorphology, have been greatly strengthened, mainly through the work by Moriyama (1983) who made a morphogenetic approach to man-made landforms resulting from opencast mining.

In September 1981, just two months preceding the AJG Symposium, the Japanese Geomorphological Union, which was established in 1979 by the cooperation of geomorphologists with related researchers, also held a symposium on the subject "Landform Development and Its Modification by Man's Impact". The papers presented at the symposium appeared as featured articles together with the record of discussion in *Transactions of the Japanese Geomorphological Union*, 3 (2), 1982 (see note (12)). Besides the keynote address, topics were presented from the engineering-side; *i.e.* case studies of artificial transformation and control of slope, river and coastal forms and processes. The discussions focused on methodologies, techniques for the measurement and prediction of man-induced changes in forms and processes, application of geomorphological data to a better modification, and the possibility of cooperative research among geomorphologists, and civil, agricultural and forestry engineers. It is estimated that this symposium has given an opportunity to geomorphologists and their neighbouring scientists and engineers to see the technological transformation of geomorphic processes and its effects on the environment in a new light.

4. Problems and Tasks

As mentioned above, in the last few years, Japanese studies on anthropogenic landform transformation have made great progress in the twin aspects, *i.e.* direct transformation and induced changes in geomorphic processes. The perception of man as an important geomorphological agent has increasingly spread from geography/geomorphology into neighbouring fields. However, some weaknesses are to be found in previous works as comprehensive studies have just started. Comparative review of Japanese studies with foreign ones (Kadomura, 1982; Kadomura and Takeuchi, 1983) has led to the conclusion that the following tasks require further research in order to promote the basic studies as well as the application to practical purposes like environmental impact assessment and management.

- 1) Socio-economic and technological assessment of factors accelerating or controlling undesirable large-scale transformation.
- 2) Enhancement of the concepts and methods of anthropogeomorphology, including the

systems of detailed mapping of man-made landforms.

- 3) Reconstruction of man-induced changes in geomorphic processes in historical times in the order of 100–1000 years and its application to the prediction of long-term changes.
- 4) Field measurement-oriented modelling of induced changes and its application to the prediction of short-term changes.
- 5) Assessment of the magnitude, areal extent and temporal sequence of the resulting effects of the induced changes on the environment.
- 6) Comparative studies between regions with different climates and socio-economic conditions.
- 7) Contribution to the integrated studies of physical environment as modified by man and to environmental management.

In conclusion, it should be stressed that most of these tasks may be valid for the acceleration of international comparative studies.

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(* in Japanese, ** in Japanese with English summary)

Table 1 Major symposia and publications on anthropic transformation of physical environment and associated problems in Japanese geography and related sciences in the past 30 years. (J): in Japanese, (JE): with English summary, (JF): with French summary, (E): in English, (F): in French. * translation by the author

Year	Association or Author	Title of Symposium (S) or Publication	Main Related Topics
1956	AJG	S1. Physico- and Socio-Geographical Research on Disasters, especially on Floods and Landslides in Japan	Effects of riparian work, dam construction, forest deterioration and gravel mining
1958	F. Tada	'Human Factors in the Geomorphological Development' (Presidential Address to the AJG)	As above and land subsidence due to groundwater withdrawal
1958	T. Chiba	"A Study of Denuded Hills", Norin Kyokai, Tokyo (J)*	Historico-geographical and ecological processes of man-induced forest deterioration
1959	T. Nakano K. Kobayashi	"Nature of Japan", Iwanami Shoten, Tokyo (J)*	Man's role in the development of deltaic plains, land subsidence, etc.
1963	AJG	S2. Geography of Flood Disasters in Relation to Urbanization*	Effects of urban development both in lowlands and hilly lands
1963	T. Nakano	"Land Below Sea-Level", Univ. Tokyo Press, Tokyo (J)*	Causes and effects of land subsidence due to groundwater withdrawal, etc.
1964	F. Tada	"Changing Physical Environment", Univ. Tokyo Press, Tokyo (J)	Effects of riparian work, dam construction, coal mining, ground water withdrawal
1964	AJG	S3. Applied Geomorphology*	Application in resources and land condition surveys, erosion control, riparian work, etc.
1964	S. Kaizuka	"Natural History of Tokyo", Kinokuniya Shoten, Tokyo, 1st ed. (J)*	A brief comment on man-made landforms in Tokyo
1964	E. Inami	"Introduction to Urban Disaster Studies", Kokon Shoin, Tokyo (J)*	Natural and man-made disasters in urban areas
1966	T. Hanya Y. Ambe	"Social Geochemistry", Kinokuniya Shoten, Tokyo (J)*	An approach to man's role from the viewpoint of social geochemistry
1966	K. Shimizu K. Nishimura T. Tanioka (1)	"Applications of Geography in Japan", Taimido, Tokyo (JFE)	Various aspects and progress in application of geography in the post-war Japan
1967	AJG	S4. Development and Use of Water Resources*	Effects of riparian work, dam construction, gravel mining on river bed variations
1967	T. Nakano	"Landforms of Japan", Tsukiji Shokan, Tokyo (J)*	Chapter on applied geomorphology touching effects of riparian work, dam construction, gravel mining, dug-in port construction, etc.

Year	Association or Author	Title of Symposium (S) or Publication	Main Related Topics
1969	K. Nishimura, ed. (2)	"Applied Geomorphology", Taimendo, Tokyo (J)*	Chapters on man-induced geomorphic changes including effects of dam construction, gravel mining, land subsidence, and direct trans-formation
1970	CGRNDS	S5. Urbanization and Natural Disasters*	Effects of urbanization on floods, landslides, land subsidence, etc.
1970	H. Koide	"Rivers in Japan: Natural and Social Histories", Univ. Tokyo Press (J)*	Physical background of river basins and its changes due to water resources development, disaster prevention work, etc.
1971	T. Nakano, ed.	"Physical Environment of Urban Areas", Kajima Shuppankai, Tokyo (J)*	Changes of physical environment and related problems including disaster prevention and nature conservation
1971	AJG	S6. Regional Development and Environmental Conservation	Problems of land subsidence, residential development on hillslopes, air pollution, etc.
1971	Y. Takahashi	"Changing Physical Environment and Flood Disasters", Iwanami Shoten, Tokyo (J)*	Historical review of effects of riparian work, water resources development and urbanization on flood disasters
1972	JAQR	S7. Change of Natural Environment	Anthropogenic transformation in the past and present; climates, landforms, rivers, vegetation, ecosystems, etc.
1972	JAQR (3)	Special Issue: as above, Quat. Res. (Tokyo), 11 (3), 85-157 (JE)	As above
1972	H. Koide	"A Study of Japanese Rivers: Regionality and Individuality", Univ. Tokyo Press, Tokyo (J)*	Regional description by river basins following Koide (1970)
1973	H. Koide	"Land of Japan: Physical Environment and Its Development", Univ. Tokyo Press, Tokyo (J)*	Historical review of land development and conservation in connection with physical background
1973	M. Kusaka	"Topographic Environment of Plains", Kokon Shoin, Tokyo (J)*	Review of previous works and historical transformation of alluvial lowlands
1974	GSI	S8. Construction Activities, Environmental Problems and Geology	Effects of construction works and role of geology in environmental management
1974	GSI, ed.	Book: "as above", Tsukiji Shokan, Tokyo (J)*	As above
1974	JSCE, ed.	"Engineering Geography of Japan", Morikita Shuppan, Tokyo (J)*	A geographical analysis of major engineering works and their effects on physical and social environments (A commemoration publication for the 60th anniversary of Japan Soc. Civil Engng.)
1975	AJG	S9. Environmental Impact Assessment for Environmental Changes Caused by Urbanization*	Discussion of geographical approach (First symposium on the topic)
1975	M. Kusaka	"Introduction to Environmental Geography", Chujin Shobo, Tokyo (J)*	Review of previous works and case studies on anthropic transformation and related problems

Year	Association or Author	Title of Symposium (S) or Publication	Main Related Topics
1976	E. Inami	"Natural Disasters in Urban Areas", Kokon Shoin, Tokyo (J)*	General aspects and effects of land development on various kinds of natural hazards
1976	S. Kaizuka	"Natural History of Tokyo", Kinokuniya Shoten, Tokyo, 2nd ed. (J)*	A brief comment on man's role in landform development
1977	JAQR, ed. (4)	"The Quaternary Period: Recent Studies in Japan", Univ. Tokyo Press, Tokyo (J)	Role of Quaternary research in the study of physical environment as modified by man
1977	A. Watanabe	"Evolution of Environmental Concepts", Environ. Inform. Sci. Center, Tokyo (J)*	Historical review on the changes in perception of man-land relationship since the Hellenic civilization and Japanese examples
1977	ECCETBS, ed. (5)	"Principles of Regional Development I: Land-forms and Land Use", Shokokusha, Tokyo (J)* (A volume in Civil Engineering Text-book Series)	Significance of landforms and their modification in construction work, regional development, disaster prevention and environmental conservation in hill-lands, plains, coastal areas, etc.
1979	TGS	S10. Centennial Lectures - Earth's Crust and Human Life	Land development and problems of natural disasters and environmental conservation
1980	TGS (6)	Special Issue: as above, J. Geogr. (Tokyo), 89 (1), 1-63 (J)	As above
1980	M. Kusaka	"Topographic Environment in Historic Times", Kokon Shoin, Tokyo (J)*	Reconstruction of natural and man-made landforms and case studies for Kinki district
1980	ECCETBS, ed. (7)	"Principles of Physical Environment III: Human Society, Environmental Development and Conservation", Shokokusha, Tokyo (J)* (A volume in Civil Engineering Textbook Series)	Perception of Nature among the Japanese and evolution of environmental concepts in geography
1981	H. Kadamura, ed. (8)	"Nation-Wide Comparative Study on Large-Scale Land Transformation and Related Environmental Problems in Japan", Report of Co-Operative Research (A) 538032, Sapporo (JE); Appendix: Tentative National Inventories of Large-Scale Land Development in Japan (J)	National inventories and regional case studies prepared in the collaboration with 20 geographers, dealing with direct transformation due to urban, agricultural and recreational land development
1981	JGU (9)	S11. Landform Development and Its Modification by Man's Impact	Subject review, case studies on artificial transformation and control of slope, river and coastal processes; discussion with a stress on methodologies, measurement, prediction and cooperative research among geomorphologists, civil, agricultural and forestry engineers

Year	Association or Author	Title of Symposium (S) or Publication	Main Related Topics
1981	AJG (10)	S12. Land Transformation and Related Environmental Changes	National summary, morphogenetic approach, historic transformation, urbanization, agricultural development, effects on physical and social environments; discussion focused on data acquisition, role of geographical approach, classification and evaluation of man-made landforms and measures against accelerated and catastrophic phenomena
1981	S. Higashi	"The Series of Cross-Dykes: Principles of Erosion Control", Hokkaido Univ. Press, Sapporo (J)*	Concepts and methods applied for reasonable erosion control and the creation and maintenance of safety environment
1981	T. Yoshikawa S. Kaizuka Y. Ota	"Landforms of Japan", Univ. Tokyo Press, Tokyo (E)	Chapter on man's role in geomorphic processes, dealing with effects of riparian work and dam construction on river channels and shore erosion, land subsidence, etc.
1981	T. Machida <i>et al.</i> , eds. TGS/UNU	"Encyclopedia of Geomorphology", Ninomiya Shoten, Tokyo (J)*	Only a few items touch the man's role as a geomorphological agent
1981	TGS/UNU	S13. The Role of Geosciences in the Development - Resources and Environment -	Role and task of geosciences in development and environmental management (Tokyo Geographical Society-United Nations Univ. Joint Symposium)
1982	TGS (11)	Special Volume: as above, J. Geogr. (Tokyo), 91 (6), 413-543 (J)	As above
1982	JGU (12)	Featured Articles: Landform Development and Its Modification by Man's Impact, Trans. J.G.U., 3 (2), 97-144 (JE)	5 paper read and deliberation at S9
1982	Kokon Shoin, ed. (13)	Special Volume: Landform Transformation and Related Environmental Changes, Geography (<i>Chiri</i>), 27 (9), 1-83 (J)*	10 papers overviews recent trends in large-scale landform transformation in Japan caused by agricultural and urban development and mining activities; photographs showing typical examples for each land use type
1983	AJG (14)	Special Issue: Landform Transformation, Geogr. Rev. Jap., 56 (4), 199-296 (JE)	Papers read at S12. Subject review, national summary, morphogenetic approach, large-scale transformation due to urban development and reconstruction of historical transformation
1983	S. Kaizuka	"Landforms of Japan from the Air", Iwanami Shoten, Tokyo (JE)	Chapter of man-made landforms including reclaimed land, reparation work, residential development, road construction, stone quarrying, etc.
1983	JASFE (15)	S14. Environmental Conservation and Environmental Geotechnics	Impact assessment of construction work, contribution to environmental management, prediction and control of land subsidence, etc.

AJG: Association of Japanese Geographers, CRGNDS: Cooperative Research Group for Natural Disaster Science, ECCETBS: Editorial Committee for Civil Engineering Textbook Series, GSI: Geological Society of Japan, JAQR: Japan Association for Quaternary Research, JASFE: Japan Association of Soil and Foundation Engineering, JGU: Japanese Geomorphological Union, JSCE: Japan Society of Civil Engineering, TGS: Tokyo Geographical Society, UNU: United Nations University.

- (1) Related Chapters in: Shimizu *et al.*, eds. (1966): Applications of Geography in Japan; Tanioka, T.: Etapes de la géographie appliquée au Japon, 1-17 (J); 223-224 (F)
Nishimura, K.: Application of physical geography, 18-29 (J); 224-225 (E)
Ichikawa, M.: Disasters caused by geomorphic accidents, 111-125 (J); 234-235 (E)
- (2) Related Chapters in: Nishimura, K., ed. (1969): Applied Geomorphology;
Ichikawa, M.: Effects of dam construction on river processes, 131-145 (J)*
Matsumoto, S.: River bed variations due to gravel mining, 146-162 (J)*
Oka, Y.: Land subsidence due to withdrawal of groundwater, 163-175 (J)*
Yamazaki, H.: Land subsidence caused by coal mining, 176-188 (J)*
Nishimura, K.: Anthropogenic transformation and a better use of landforms, 189-200 (J)*
- (3) Related Articles in: Quat. Res. (Tokyo), 11 (3), 1972;
Tada, F.: Human forces in the geomorphological development, 85-86 (JE)
Takahashi, Y.: Alternation of riparian environment, 112-116 (JE)
Iseki, H.: Changes on the deltaic plains in Japan, 117-124 (JE)
Gohara, Y., Shimbori, T. and Shibazaki, T.: Alternation of environment in the aspects of Quaternary geology, 125-134 (JE)
Kadomura, H.: Some problems on the study of environmental deterioration induced by man, 142-150 (JE)
- (4) Related Chapters in: JAQR, ed. (1977): The Quaternary Period: Recent Studies in Japan;
Shimbori, T.: Environment and human activity, 269-278 (J)
Kusaka, M.: Man's agency on land, 279-288 (J)
Kuwahara, T. and Nirei, H.: Application of Quaternary studies, 303-319 (J)
Yoshikawa, T.: Quaternary researches in Japan: Its achievement and prospect, 353-361 (J)
- (5) Related Chapters in: ECCETBS, ed. (1977): Principles of Regional Development I;
Tamura, T.: The mountains and hills - With special reference to the landform of the hill-lands and its utilization and anthropic deformation, 1-73 (J)
Takahashi, Y.: Rivers, 75-120 (J)*
Matsuda, I.: Plains, 189-257 (J)*
- (6) Aramaki, M.: Coastal environment, 259-320 (J)*
Related Articles in: J. Geogr. (Tokyo), 89 (1), 1980;
Nakano, T.: Recent characteristics of earthquake disasters, 41-51 (J)
- (7) Nishikawa, O.: History of national land development and conservation problems, 52-59 (J)
Related Chapters in: ECCETBS, ed. (1980): Principles of Physical Environment III;
Chiba, T.: Perception of Nature among the Japanese, 35-82 (J)*
Nishikawa, O.: Nature, man and technology: A review on conceptual development, 83-107 (J)*
Takahashi, Y.: Nature and its development by civil engineering technologies, 265-308 (J)
Results of 2-year organized research prepared in the collaboration with T. Abe, Y. Akagi, K. Arai, N. Hori, T. Imagawa, H. Kadomura, M. Kusaka, I. Matsuda, S. Matsumoto, A. Moriyama, I. Nakabayashi, M. Okamoto, T. Oishi, H. Takahashi, K. Takeuchi, T. Tamura, Y. Watanabe, H. Yamamoto, S. Yoshioka, and N. Yoshizu.
- (9) Papers read at this symposium were published in 1982; see note (12).
- (10) First symposium on the topics in the AJG and 10 papers were read;
Tamura, T., Yamamoto, H. and Yoshioka, S.: National summary of recent studies on large-scale land transformation.
Moriyama, A.: Genetic approach to man-made landforms resulting from porcelain clay mining in the Seto Area.
Tanaka, S. and Okimura, T.: Land transformation due to urbanization in the Rokko Mountains, Kobe, Kinki Metropolitan Area.

- Yamakawa, T.: Land transformation attendant on urbanization in Western Kanagawa Prefecture.
 Higashi, S.: Role of forest management in the exploitation of mountainous environment.
 Tateishi, T.: Coastal sand dunes historically inherited from planting for erosion control, a case of Shonai Sand Dunes.
 Kusaka, M.: Implications of ancient land transformation in the olden provinces of Settsu, Kawachi and Izumi.
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