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Towards Interdisciplinarity

Experiences of the Long-term ACACIA Project

Edited by

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Preface

This volume combines eight essays on various aspects of interdisciplinarity accompanied by several case studies serving to demonstrate the application of transdisciplinary methods and techniques. The teams of authors belong to different disciplines collaborating in the same research projects. The essays focus on specific scientific questions, but more important are the perspectives under which these questions are viewed together with the trans- and interdisciplinary methods that are applied for their solution. Thus, the interplay of various disciplines with their specific methods concentrating on a scientific subject or a cluster of interrelated subjects is the main topic of this volume.

In this context all contributors to this volume speak of ‘interdisciplinarity’. However the reader will soon realise that the authors often have different definitions in mind. This is certainly due to the fact that the concept as such is still remote from having found a generally accepted definition, but also caused by the editors’ reserve to propose a unified and somehow binding definition of interdisciplinarity, simply in order to avoid the effect of a straightjacket for the creative thinking of the authors. Instead, the editors had in mind to trigger real accounts of how scientific collaboration crossing the disciplinary boundaries had been practised during the twelve years between 1995 and 2007 that the *ACACIA* (Arid Climate, Adaptation and Cultural Innovation in Africa) Collaborative Research Centre¹ lasted.

Within the context of a wider concept of African Studies, the *ACACIA* research programme brought together between forty and fifty scholars from the two Universities of Cologne and Bonn. They belonged to different institutes within their Universities and represented eight basic disciplines. These were: African Linguistics, Botany, Ecology, Egyptology, Geography, History, Social Anthropology (Ethnology), Prehistory (Archaeology) with various sub-branches. The collaborative research was organized in 29 long-term projects focusing on the arid and semi-arid regions in Northeast and Southwest Africa, where they scrutinized human adaptation under ecologically critical conditions over a period from the beginning of the Holocene up to present times².

¹ ACACIA was financed by the German Research Foundation (*Deutsche Forschungsgemeinschaft*) and the Government of the Federal State of North Rhine-Westphalia between 1995 and 2007. Our deep-felt thanks go to these institutions for their financial and moral support.

² Further details: <http://www.uni-koeln.de/inter-fak/sfb389/index.htm>

Some projects lasted for the whole lifetime of the Research Centre, others only for some years. All projects had their counterparts in African Universities. During the active teaching periods of the Universities regular colloquia on a weekly basis were organized, where in principle all members of *ACACIA* met either for presenting and discussing their interim results or listening to lectures on topics of general interest to the main theme of *ACACIA*. Anyway, for the participants of *ACACIA*, transdisciplinary collaboration was a prerequisite. The regular encounters of the participants were a further incentive to learn about the thinking and the terminologies of the partner disciplines.

The organizers of the Research Centre had always been aware that interdisciplinarity is only an ideal goal that cannot be reached by marching in step, but a goal that depends on various factors and conditions that could be supported from outside, but had to grow by experience from inside. In retrospect, the most important factors appear to be the mutual awareness of the discipline specific ways of thinking among the partners of the collaborating disciplines and the willingness of the researchers to cross their disciplinary boundaries.

Only when reflecting on the methodology of the contributions to this volume, it became apparent that there are evidently different ways to achieve interdisciplinarity. To our present knowledge, there are three different strategies altogether. These are the accumulation strategy, the discourse strategy and the amalgamation strategy. Instead of arranging the papers in an alphabetic order, we use these strategies as the leading criteria to organize the essays in three parts. As we hope, this arrangement will facilitate comparison and understanding of an otherwise complicate issue.

As the contributions to this volume testify, in our view the results of the transdisciplinary collaboration within *ACACIA* are extremely fruitful and are worth to be made known to a larger public. It is part of common academic ethics to consider the way to be the goal and to believe in the eternal progress of knowledge. Therefore, we have arranged this collection of trans- and interdisciplinary case studies under the motto of ‘T o w a r d s Interdisciplinarity’.

Cologne, Heidelberg, Bonn, May 2010

Wilhelm J.G. Möhlig, Olaf Bubenzer, Gunter Menz

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Towards Interdisciplinarity: An Introduction Based on the Experiences of the Collaborative Research Centre ACACIA

Wilhelm J.G. Möhlig

0.1 Interdisciplinarity a programmatic goal

As our experience within the Collaborative Research Centre *ACACIA* (Arid Climate, Adaptation and Cultural Innovation in Africa) shows, ‘interdisciplinarity’ as a property of collaborative research projects cannot be ordered nor enforced. In fact it will only develop under certain circumstances. In our view, the most important ones are:

- (1) The complexity of the scientific question that is in the focus of research;
- (2) The objective compatibility of the disciplines involved in the same scientific question;
- (3) The mutual awareness of the discipline specific ways of thinking among the partners of the collaborating disciplines;
- (4) The willingness of the researchers to cross their disciplinary boundaries.

In the following sections, we comment on these conditions in more detail.

0.1.1 Complexity of the scientific question

Scientific questions that are in the focus of several disciplines usually tend to be complex in as far as they open up different perspectives and often require different approaches to explore their essence or truth. For instance long-lasting historical processes, eventually with more or less serious consequences for the future like global warming or environmental degradation fall under this category.

All case studies in this volume deal with scientific questions that are characterised by their historical and/or future dimensions. This is not accidental, since already the general topic of the *ACACIA* Research Centre provides a historical framework. It is dedicated to the interrelationship between the geo-ecological dynamics and the cultural adaptation of the African population under the increasing aridity in NE- and SW-Africa during the whole Holocene. For all sub-projects collaborating

under the roof of *ACACIA* this complex topic requires at least transdisciplinary, if not interdisciplinary collaboration.

0.1.2 Objective compatibility of the collaborating disciplines

The compatibility of disciplines is a property that is independent of the traditional system of sciences or the organisation of institutions and departments within a university. Although the disciplines united within *ACACIA* belong to the so-called humanities and also to the natural sciences, the decisive common feature is their `empirical orientation`. This automatically implies that they share the three procedural stages of collecting, upgrading and analysing field data before they draw their individual scientific conclusions.

What we only realized when *ACACIA* was already on its way: Another important commonality was the `choice of the same areas of research`. The research teams of *ACACIA* did not only use the same logistic means (cars, field camps, field equipment etc.), but often travelled together to the same regions in the same periods of time. This provided ample opportunity for the researchers to exchange experiences and to discuss scientific problems that at a first glance appeared to be discipline specific but later turned out to be of transdisciplinary interest if not importance.

Since these features describe more the external conditions of commonality, we subsume them under the cover term of ‘objective compatibility’, whereas the following two conditions of the catalogue can rather be subsumed under the category of ‘subjective compatibility’.

0.1.3 Mutual awareness of the discipline specific ways of thinking

It requires a certain degree of curiosity on the side of the collaborating partners about the specific thinking of the partner disciplines. Such curiosity is usually aroused if the scientific questions happen to be the same. For instance, in the complete absence of written or oral historical documents, it became in a way fashionable that historical comparative linguists and archaeologists with the help of their own methods tried to unravel the pre-colonial cultural history of Africa, in particular the spread of iron industries during the first millennia AD. In many cases, however, the so-called “interdisciplinary” collaboration resulted in vicious circles: The archaeologists took the historical linguistic hypotheses about the past as hard facts for their computations and the historical linguists at a subsequent stage evaluated these archaeological computations as a proof for their own hypotheses (EGGERT 1981: 322).

In our view, the main reason for this type of interdisciplinary “cloning” (MÖHLIG 1989: 189f) lies in the different directions of epistemic thinking: The archaeologists start their deductions or computations at the pre-historical level of their finds and with their interpretations move towards the direction of the present times. On the contrary, the historical linguists start from the empirical basis of the modern languages and with their computations move towards the direction of the past. Because of the different directions of epistemic thinking the two disciplines are basically incompatible. In such cases, the same locality is often taken as the common denominator for both disciplines assuming silently that the modern language cultures above the surface are identical with the archaeologically identified cultures below the surface. Yet, when oral or even written historical sources become known, they reveal that the present speakers of the languages have been living in that locality of joint research no longer than for a few generations. Evidently there are only few regions in Africa where a cultural continuity over hundreds or even thousands of years is given. In most cases, the likelihood that the results of an archaeological computation and an historical linguistic computation meet decreases the longer the temporal distance between the horizon of the archaeological finds and the present state of languages is. So far, we know of only two sub-projects within *ACACIA*, where a systematic attempt at overcoming the incompatibility between archaeology and historical linguistics was made. The first of JESSE & KLEIN-ARENDT concerns a joint project on Nubian pottery (2007; Part II of this volume), the second study of KOSE & SEIFERT (also included in this volume) concerns the spread of pre-historical iron industries at the Central Kavango. In the first essay a relative stability of the ancestral links of the producers of artefacts below the ground and the population above the ground appears to be proven. In the second essay, the level of the archaeological finds is still within the horizon of oral history and mythology. In other words the two disciplines can meet so to speak within sight.

0.1.4 Willingness of the researchers to cross disciplinary boundaries

In the context of essential pre-requisites, the willingness of the researchers of different disciplines to cross their disciplinary boundaries and to learn from each other even the terminologies and the specific ways of thinking proves to be another important feature of trans- or interdisciplinarity.

The experts of a specific scientific field or a so-called discipline are responsible for the application and processing of their methods. These agents must be motivated to cross their discipline boundaries, whereby it does not matter whether they feel the necessity because of the complexity of the research topic or whether they are only curious to learn from neighbouring disciplines.

Within *ACACIA* such willingness was certainly favoured by weekly gatherings of all researchers who were not on field trips and working in their home offices or laboratories. At these multidisciplinary gatherings the states of the *ACACIA* sub-projects were presented and discussed. Eventually the gatherings even resulted in new methodological discoveries. For instance, semanticists dealing with the conceptual systems of natural landscapes in Africa found it difficult if not impossible to compare these systems between different languages, even if the languages to be compared belonged to the same genetic clusters. To their amazement the incongruity of the conceptual systems could be overcome, when each conceptual system was subsumed under the “objective” parameters of the general system of geo-morphologic parameters used by physical geographers to describe landscapes everywhere in the world (MÖHLIG 2009: 431ff). The potential of this device could only be discovered and successfully applied because geo-morphologists and linguistic semanticist happened to work side by side.

0.2 Terminological confusion in the context of interdisciplinarity

So far, three terms have played a major role in the international (e.g. BUANES & JENTOFT 2009; HUUTONIEMI ET AL. 2010) and also in the internal discourse of the *ACACIA* Research Centre. These terms are ‘multidisciplinarity’, ‘transdisciplinarity’ and ‘interdisciplinarity’. The word constituent ‘discipline’, which these terms share, should not be confused with the administrative subunits of universities also called disciplines, but understood as the intersection of different fields of scientific interests and of different scientific methods that are administered by particularly trained experts. Hence, in this sense, ‘discipline’ basically means bundle of scientific methods usually applied to solve specific scientific problems or questions. As far as the *ACACIA* projects are concerned, the scientific questions to be solved have a clear pragmatic dimension. It therefore appears appropriate that we restrict the following reflections to this aspect of interdisciplinarity, while being aware that other dimensions also exist.

0.2.1 Multidisciplinarity

Among the terms named, multidisciplinarity is the most general notion in as far as it only implies that several scholars who are experts at different methods work on a question of common interest but parallel and without integration neither during their investigations nor in the formulation of their results. In a multidisciplinary context it therefore does not matter whether the results are congruent, partially different or even contradictory. In general, divergent results are left to third parties for evaluation, for instance to politicians to draw their own conclusions, if they think that further action be required.

0.2.2 Transdisciplinarity

Transdisciplinarity implies a situation where two or more disciplines cross their disciplinary borders and practice some degree of methodological collaboration. If the projects are empirically based, as this is the case with all projects within the *ACACIA* Research Centre, the epistemic process is usually organised in five stages:

1. The formulation of initial hypotheses or scientific questions that trigger further research;
2. The collection of empirical data;
3. The upgrading of the empirical data for specific processes;
4. The analysis of the data;
5. Drawing conclusions with respect to the initial hypotheses.

The transgression of the disciplinary boundaries may happen at any of the five stages and from both sides of the collaborating disciplines. As the interdisciplinary profiles of the case studies in this volume show (see below section 3), the disciplinary boundaries may be crossed at the first stage, the last stage or somewhere in between. It only matters that the transgression across the disciplinary boundaries occurs with the support of all the partners concerned.

0.2.3 Interdisciplinarity

Interdisciplinarity refers to the highest degree of methodological fusion and integration of two or more disciplines with respect to their ways of thinking, to their analytical techniques and their finding solutions for a common scientific problem. "Interdisciplinarity is thus best understood not as one thing but as a variety of different ways of bridging and confronting the prevailing disciplinary approaches." (HUUTONIEMI ET AL. 2010: 80).

As several authors claim (MÖHLIG 1989; KLEIN 1996; NEWELL 2001), interdisciplinary collaboration needs a *meta-methodology*, i.e. specific rules and principles according to which interdisciplinary collaboration is organized. In the essays of this volume at least three strategies for achieving interdisciplinarity are exemplified:

- (1) The accumulation strategy;
- (2) The transdisciplinary discourse strategy;
- (3) The amalgamation strategy.

0.2.3.1 The accumulation strategy

In two articles of this volume, namely in BUBENZER & BESLER and in FÖRSTER, RIEMER, BOLTEN, BUBENZER, HENDRICKX & DARIUS, the accumulation strategy is

practiced. At the beginning of each project, the partners formulate a common multifaceted problem that requires at least a multi-disciplinary approach. During the subsequent empirical phases, the problem is independently tackled by the collaborating disciplines according to their own methods and approaches. Because of their different perspectives, the participant researchers expect right from the beginning that, with respect to the initial question, they achieve only partial results. Therefore, after the phase of mono-disciplinary analyses, a transdisciplinary interim stage is inserted where the partial results are homogenized under the aspect of cumulative indications pointing towards the same direction. This formula says that those elements in the partial results that are indicative for a joint conclusion regarding the original question are selected and weighted. At this stage of the transdisciplinary procedure, the factor of probability is introduced. With its help, the coinciding results are interpreted as circumstantial evidence for the final hypotheses that may be offered as the common solution to the initial scientific question. This strategy is similar to the investigations in criminal cases, where at the end the accusations and even sometimes the judgements are also based on circumstantial evidence and not on sworn testimony.

During the final stage of the epistemic process following the accumulation strategy, two elements that also occur within the context of the transdisciplinary discourse strategy (see the following section 2.3.2) are introduced, i.e. a trial-and-error procedure and transdisciplinary negotiations. This is justified because partial results of this sort can rarely be put together as in a puzzle. In most cases they have to be adjusted in a trial-and-error procedure, and the adjustment as such has to be negotiated among the participating researchers. The major difference with the transdisciplinary discourse strategy (see below) appears to be that in the epistemic process of the accumulative strategy, these two elements are introduced at a comparatively late stage, whereas in the transdisciplinary discourse strategy they may be present right from the beginning of the epistemic process.

0.2.3.2 The transdisciplinary discourse strategy

According to this strategy, the integration of different disciplines is organized in three steps.

First, the collaborating disciplines enter into a permanent discourse, during which it must be always transparent: (1) who takes (2) what (3) from whom (4) at which point of the transdisciplinary process.

Second, the epistemic process during this discourse is recursive, i.e. it follows a trial-and-error strategy. Ideally, the partner disciplines permanently re-evaluate their interim results and question the

underlying assumptions and hypotheses, if necessary, several times.

Third, the final result with respect to the initial problem to be solved has to be transparent in as far as it shows the shares of all contributing disciplines.

Whereas the first step means only keeping a record in order to help realising the second step of recursiveness, the second step clearly contradicts the rigidity of scientific thinking that is often claimed in mono-disciplinary deductions and conclusions. Therefore, to guarantee the scientific character of the whole process and to avoid the production of “science fiction”, the third step of transparency is needed. In order to prove that the final results are not achieved by simple cloning the hypothetical computations of different disciplines or by a vicious circle within the chain of multidisciplinary deductions, an account in the sense of the first principle is needed saying (1) who actually did take (2) what (3) from whom (4) at what stages of the knowledge producing process.

Three essays of this volume fall under the transdisciplinary discourse strategy. The first contribution by MÖHLIG, SEIDEL & SEIFERT focuses in particular on the discourse character of interdisciplinary processes. In three case studies that are all dedicated to different ethnohistorical questions, the authors analyse stepwise the discourses between the participating disciplines. Ethnohistory mostly takes the role of the questioner, whereas the other disciplines, which in their majority belong to the natural sciences, take the role of respondents. In particular the recursive character of the discourses is demonstrated.

The second essay by JESSE & KLEIN-ARENDRT presents an innovative approach to overcome the temporal gap between the horizons of the archaeological objects (a special type of pottery) and the modern language cultures (Nile Nubian) of more than a millennium. The authors introduce a common set of descriptive parameters that can equally be used by the archaeologist specializing in ancient pottery and by the historical linguist. This procedure results in two kinds of interlinked texts that can be compared to discover cultural influences from outside or other historical dynamics that might have occurred between the two temporal levels. In this case study the transdisciplinary collaboration starts already at the first stage of the epistemic process, when the empirical data are selected jointly by both disciplines. The conclusions drawn with respect to ethnohistory are largely based on plausibility.

In the third case study falling under the discourse strategy, KOSE (archaeology) and SEIFERT (comparative oral literature) start their transdisciplinary collaboration also at the beginning of the epistemic process, where the scientific question is formulated and the data are selected. In this case the archaeologist is working at a temporal level of not more than 500 years before present. This horizon is also reached

by the modern narrative texts that the historical linguist analyses with respect to their motifs and other elements of oral history. Therefore the results in terms of ethnohistory have a higher degree of certainty than those of the previously described case study.

0.2.3.3 The amalgamation strategy

Three contributions to this volume follow mainly the amalgamation strategy. The first study by BOLTEN & DIECKMANN is dedicated to the processing of historical-anthropological data on the economic and settlement history of former European farmland in Namibia with the help of a Geographical Information System (GIS). Interdisciplinarity is introduced already at the stage of data collection in as far as the GIS procedure is fed with historical-anthropological data. These are carried over from one epistemic stage to the other. At the final stage an innovative model with a future perspective is formulated.

The second study of this type by MENZ & RICHTERS focuses on the development of a remote sensing model with respect to biomass production in NW-Namibia. The model combines satellite radiation data of high spatial and temporal resolution from the TERRA EOS-1 MODIS system with extensive ground truth biomass data collected during several field visits to the reference area in Kaokoland (NW-Namibia). The complexity of the scientific problem requires an interdisciplinary approach, which in this project is realised by the combination (amalgamation) of data sets whose selection is defined by remote sensing methods. The further epistemic procedure follows the principles of both intertwined methods

In a third example following the amalgamation strategy, the social anthropologist Julia PAULI demonstrates the merger of originally two different disciplines, namely social anthropology and demography. Her practical example is the social institution of marriage as an indicator of population dynamics in the Namibian semi-urban society of Fransfontein. The empirical data are collected with the usual social-anthropological methods. But already at the upgrading phase, a basically demographic approach is introduced in as far as the anthropological field data are subsumed under demographic parameters. At the epistemic stage of analysis, this amalgamated procedure leads to innovative anthropological-demographic correlations. The author convincingly argues that the results could not have been achieved by either of the parent disciplines alone.

0.3 Comparison of the individual interdisciplinary profiles

0.3.1 Trans- respectively interdisciplinary profiles as common denominators

The experiences with the sub-projects of the *ACACIA* Research Centre show that interdisciplinarity is a gradual epistemic process. It starts with crossing the disciplinary boundaries gradually acquiring transdisciplinary competence in understanding the specific terminologies and methods of the partner disciplines. For the functioning of this process, it is irrelevant whether the transdisciplinary collaboration is triggered because the researchers are working in the same region or whether the object of research is so complex that it can only be mastered by several disciplines whose collaboration is therefore required by the circumstances of the case. In this context it is important to note that over twelve years the disciplines that have been working within the *ACACIA* Research Centre were in a permanent discourse about the aims of their projects, their progresses and their results so that in any case transdisciplinarity was guaranteed and interdisciplinarity could quasi naturally grow.

The case studies in this volume exemplify the combination of various disciplines. It is most likely that the choice of disciplines working together has an influence on the degree or intensity of interdisciplinary integration and on the choice of the interdisciplinary strategies for solving specific scientific questions. However, the complexity and the multitude of these factors make it difficult to directly compare the degree of interdisciplinarity between the various case studies. Therefore in the sphere of meta-methodology an abstract system of comparison is needed that can operate as a common denominator for measuring the degree of interdisciplinarity of the case studies in this volume. Since all of them share an orientation towards empirical research, we propose an abstract system of comparison that is based on the epistemic stages that all empirical research projects usually follow. In other words, we measure the transdisciplinary respectively interdisciplinary profile of each case study according to the following scheme:

	Epistemic Process	Assessment
1 st stage	Formulation of scientific questions	?
2 nd stage	Data collection	?
3 rd stage	Upgrading (processing) of the data	?
4 th stage	Analysis of the data	?
Interim stage	Accumulation of mono-disciplinary results [only valid for projects following the accumulation strategy]	?
5 th stage	Conclusions and forming hypotheses with respect to the scientific question(s) formulated at 1 st stage	?

Our basic parameters of assessment are: (1) mono-disciplinary, (2) transdisciplinary and (3) interdisciplinary. At the methodological level, ‘mono-disciplinary’ means the application of such methods and procedures that are usually administered by trained experts of a specific discipline. Correspondingly ‘transdisciplinary’ designates an epistemic procedure where certain elements of one disciplinary-bound method are integrated into the methods of a collaborating discipline. Finally, ‘interdisciplinary’ means that specific elements of two or more methods merge preferably by means of an active discourse between the partner disciplines so that the merger is transparent according to the bundle of cardinal questions: ‘Who takes what from whom at which point of the transdisciplinary process?’

Three modes of application can be distinguished: (1) planning, (2) performance and (3) evaluation.

These modes are characterized by different values. (1) A value may be mono-disciplinary, if the methods of one partner discipline dominate. (2) Or it may be parallel, if the collaborating disciplines with a view of a future merger follow their own principles for a while before partially merging at a later stage of the epistemic process. (3) The mode may consist of a complete methodological amalgamation. (4) It may be transdisciplinary if only certain methodological elements of the partner disciplines are used in the further epistemic process. (5) Finally the value may be interdisciplinary, if the transdisciplinary merger in view of a specific scientific problem has been guided by a meta-methodology negotiated among the partner disciplines.

In the following sections, we use this abstract scheme as a *tertium quid* for defining the interdisciplinary profile of each case study in order to make it thus comparable to all the other case studies in this volume.

0.3.2 Part I: Projects Following Predominantly the Accumulation Strategy

0.3.2.1 Sands as Archives of Environmental Change: Examples from Egypt, Sudan and Namibia

by Olaf BUBENZER & Helga BESLER

The three case studies within this essay focus on different African regions: the Great Sand Sea in western Egypt, the northern bank of Wadi Howar near Jebel Rahib and the Coastal Namib Sand Sea in the southwest of the African continent. The sand samples that are taken from these areas are exploited as geo-archives documenting the environmental dynamics of past eras. They are processed by a ‘multi-scale’ approach. The authors understand this term as the application of geomorphological and sedimentological techniques in three dimensions:

- (1) Macro-scale = satellite-image interpretation;
- (2) Meso-scale = field measurements and sampling;

- (3) Micro-scale = laboratory analyses, morphocopy and Scanning-Electron Microscopy (SEM).

In addition to the geomorphologic and sedimentological analyses, wherever possible, the results are correlated with chronologies rendered by radiocarbon and luminescence techniques based on archaeological artefacts from the same or from immediately neighbouring areas.

For all the three case studies, interdisciplinary collaboration is already planned at the first epistemic stage when formulating a common scientific goal. During the subsequent stages the methods and techniques of the participating disciplines are applied in a mono-disciplinary way. At an interim stage of the epistemic process the partial results of the parallel procedures are weighted and combined as cumulative indications pointing towards the same direction. In our comparative meta-terminology, the procedure as such can be evaluated as recursive discourse.

An additional feature of this essay is the support rendered by archaeological methods to prove human occupation. On the one hand, the archaeological computations are used to establish a chronology for the different phases of the natural history. On the other hand, almost as a by-product, the archaeological expertise comes to the conclusion that 10,000 years ago in the northern areas human occupation was significantly more intensive than in the south.

The case studies within this essay show more or less the same interdisciplinary profile:

	Epistemic Process	Assessment
1 st stage	Formulation of scientific questions	Interdisciplinary planning
2 nd stage	Data collection	Mono-disciplinary performance
3 rd stage	Upgrading (processing) of the data	Parallel performance
4 th stage	Analysis	Parallel performance
Interim stage	Accumulation of mono-disciplinary results	Interdisciplinary performance in recursive discourse
5 th stage	Conclusion with respect to scientific question	Interdisciplinary evaluation in recursive discourse
Addition	Conclusions with respect to human settlement in addition to the focus of the project	Interdisciplinary evaluation in recursive discourse

0.3.2.2 Tracing Linear Structures: Remote Sensing, Landscape Classification and the Archaeology of Desert Roads in the Eastern Sahara
 by **Frank FÖRSTER, Heiko RIEMER, Andreas BOLTEN, Olaf BUBENZER, Stan HENDRICKX & Frank DARIUS**

The common topic for all disciplines and methods involved in this essay is the reconstruction of long-distance caravan routes in Egypt's Western Desert, which some thousand years ago played an important political and economic role. The five case studies called "approaches" are planned with an interdisciplinary perspective. However the subsequent epistemic stages of empirical data collection, upgrading and analysis are carried out in a multidisciplinary mode, parallel and independently according to the inherent rules of the collaborating disciplines. In addition, archaeological methods are used for dating and for chronology, but also for reconstructing qualitative details concerning the travelling modes and even the cognitive aspects of navigation on these roads.

The essay is structured in five sections called "boxes", in which the mono-disciplinary activities with their interim results are described. At the end, these interim results are combined as cumulative information with regard to the reconstruction of the actual course of the ancient caravan route. This essay shows the following interdisciplinary profile:

	Epistemic Process	Assessment
1 st stage	Formulation of scientific questions	Interdisciplinary planning
2 nd stage	Data collection	Mono-disciplinary performance
3 rd stage	Upgrading (processing) of the data	Parallel performance
4 th stage	Analysis	Parallel performance
Interim stage	Accumulation of mono-disciplinary parallel results	Interdisciplinary performance in recursive discourse
5 th stage	Conclusion with respect to scientific questions	Interdisciplinary evaluation in recursive discourse
Addition	Conclusion with respect to chronology and human activities	Interdisciplinary evaluation in recursive discourse

0.3.3 Part II: Projects Following Mainly the Transdisciplinary Discourse Strategy

0.3.3.1 The Interdisciplinary Dimension of Linguistic Historiography by Wilhelm J.G. MÖHLIG, Frank SEIDEL & Marc SEIFERT

Like sands (see section 3.2.1), the modern linguistic inventories are not historical archives *per se*. Yet they are the result of historical processes being at least partly influenced by the history of the human beings that speak these languages. With our increasing knowledge of non-linguistic history – e.g. oral tradition, archaeological finds and natural history – we discover more and more historical evidence explaining dynamic processes that are visible in the linguistic records, namely linguistic diffusion, stratification, borrowing and conversion. In other words, the finds of the non-linguistic disciplines evidently form a *s c e n a r i o* that may serve to interpret the historical linguistic reconstructions in terms of ethno-history. This kind of interdisciplinary collaboration has two characteristics: On the one hand, it is structured as a *d i a l o g u e* between the disciplines forming the scenario and historical linguistics. On the other hand, this dialogue is *r e c u r s i v e* in the sense of a trial-and-error process. As a consequence the exchange of preliminary results has to pass eventually a specific transdisciplinary dialogue several times until a common result is achieved.

In the three case studies within this essay, partnerships with different disciplines have been entered. In all these examples, the starting questions for the partner disciplines aim at the ethno-history of a particular population or region in Africa. According to the meta-methodological parameters described above this essay shows the following interdisciplinary profile:

	Epistemic Process	Assessment
1 st stage	Formulation of scientific questions	Interdisciplinary planning
2 nd stage	Data collection	Transdisciplinary performance
3 rd stage	Upgrading (processing) of the data	Transdisciplinary performance
4 th stage	Analysis of the data	Interdisciplinary performance in recursive discourse
5 th stage	Conclusions with respect to scientific questions	Interdisciplinary evaluation in recursive discourse

0.3.3.2 Putting Together Archaeology and Historical Linguistics: The Case of Pottery
by Friederike JESSE & Reinhard KLEIN-ARENDR.

This essay is based on the interdisciplinary collaboration of an archaeologist (JESSE) and a historical linguist (KLEIN-ARENDR). The objects of the joint research are so-called *qadus* pots (water containers) of the first millennium A.D., which are found in the territory of so called Nile Nubians. In their project, the authors aim at bridging the gap between the era where the pots were fabricated and the modern Nile Nubian dialects that are spoken in the same area where the ancient pots are found. Outside the participating disciplines, there is strong evidence that a Nubian population has been living in the same region since the time line of the archaeological finds. The research aims at clarifying internal cultural changes and the effects of external influences. In this perspective, the project is organised in two stages: At a first stage, the ancient pots are segmented into composite parameters referring to size, form, outer appearance, technique of manufacture etc. At a second stage, the parameters serve the linguist as an interrelated semantic grid for allotting the notions used for them in the modern Nile Nubian dialects. This procedure, which is methodologically based on an earlier study of KLEIN-ARENDR (2004), allows defining what elements are ancient, still in use or testify an external cultural influence. The interdisciplinary profile is as follows:

	Epistemic Process	Assessment
1 st stage	Common formulation of scientific question	Interdisciplinary planning
2 nd stage	Data collection	Interdisciplinary performance in recursive discourse
3 rd stage	Upgrading (processing) of the data	Transdisciplinary performance
4 th stage	Analysis of the data	Interdisciplinary performance in recursive discourse
5 th stage	Conclusions with respect to scientific questions	Interdisciplinary evaluation in recursive discourse

0.3.3.3 The History of Iron Working at the Central Kavango: An Attempt at Interdisciplinary Collaboration
by Eileen KOSE & Marc SEIFERT

Based on a cooperative research about the reintroduction of iron melting at the Central Kavango, the authors of this case study presents approaches towards an interdisciplinary conception of historical research in Africa comprising all epistem-

ic stages from the formulation of a common object of research up to the stages of analysis and formulating a common hypothesis on its results. The study focuses on the distribution of archaeological finds of ancient iron melting with the actual distribution of motifs and other elements in the records of narrative literature in the same area. In this case, the authors overcome the basic incompatibility in the epistemic thinking of the partner disciplines and achieve plausible historical conclusions, because the archaeological horizon lies more or less within the horizon of oral history including the horizon of historical myths, i.e. not earlier than 300 to 400 years before present. The project is planned right from the beginning in an interdisciplinary perspective. According to that plan, the collection and upgrading of archaeological evidence and the selection of modern textual evidence is coordinated. Interdisciplinary discourse dominates analysis and conclusions. This joint project shows the following interdisciplinary profile:

	Epistemic Process	Assessment
1 st stage	Formulation of scientific question	Interdisciplinary planning
2 nd stage	Data collection	Transdisciplinary performance
3 rd stage	Upgrading (processing) of the data	Transdisciplinary performance
4 th stage	Analysis of the data	Interdisciplinary performance in recursive discourse
5 th stage	Conclusion with respect to scientific question	Interdisciplinary evaluation in recursive discourse

0.3.4 Part III: Projects Following Predominantly the Amalgamation Strategy

0.3.4.1 The Use of GIS for Analysing and Visualizing Historical Socio-economic and Ecological Farm Data in the Outjo District / Namibia by Andreas BOLTEN & Ute DIECKMANN

This project focuses on the application of the geographical method of GIS on data that have formerly been collected by a historical-anthropological project on vulnerability and risk management of farmland in the Outjo district (Namibia). One of the goals is a visual upgrading (representation) of the anthropological data, but beyond that, it is intended to discover systematic correlations of the various anthropological datasets. In other words, the transdisciplinary amalgamation of anthropology and GIS starts already at the stage of data collection. The close integration of the two disciplines is continued up to the final epistemic stage of conclusions and forming scientific hypotheses. Thus, this contribution shows the following interdisciplinary profile:

	Epistemic Process	Assessment
1 st stage	Formulation of the scientific question	Interdisciplinary Planning
2 nd stage	Data collection	Transdisciplinary amalgamation
3 rd stage	Upgrading (processing) of the data	Transdisciplinary performance
4 th stage	Analysis of the data	Interdisciplinary evaluation in recursive discourse
5 th stage	Conclusions with respect to scientific questions	Interdisciplinary evaluation in recursive discourse

0.3.4.2 Biomass Production in NW-Namibia: A Remote Sensing Modelling Approach by Gunter MENZ & Jochen RICHTERS

The research project aims at providing reliable information on the production of above ground biomass and on the available pastureland for cattle in Kaokoland (NW Namibia). A new model of calculating biomass production in combining ground datasets with data provided by satellite observation is developed. In future this may be used to achieve model an ecologically oriented nomadic pasture balance to identify overgrazing and land degradation as well as for the assessment of regional carbon sinks in the context of a global climate change. The geographical ground data and the satellite data have been amalgamated at the epistemic stage of upgrading. The integrated datasets have been epistemologically processed up to the stage of scientific conclusions. Thus, this essay shows the following interdisciplinary profile:

	Epistemic Process	Assessment
1 st stage	Formulation of scientific question	Interdisciplinary planning
2 nd stage	Data collection	Mono-disciplinary performance
3 rd stage	Upgrading of the data	Transdisciplinary amalgamation
4 th stage	Analysis of the data	Interdisciplinary evaluation in recursive discourse
5 th stage	Conclusion with respect to scientific question	Interdisciplinary evaluation in recursive discourse

0.3.4.3 Demographic and Anthropological Perspectives on Marriage and Reproduction in Namibia by Julia PAULI

Focusing on the anthropological category of marriage the paper discusses broadly the factors of population dynamics in the township of Fransfontein (Northwest Namibia). The author has chosen the social institution of marriage instead of other social phenomena like fertility or age, because this topic is in the focus not only of anthropology but also of demography. In the past both disciplines with their different perspectives and methods have developed a scientific interest in the institution of marriage.

The author describes that the close transdisciplinary collaboration of anthropology and demography in the fields of marriage, fertility, mortality, HIV and other related subjects has caused the merger of the two disciplines to form the new discipline 'anthropological demography'. In her case study, PAULI exemplifies the amalgamated method and discusses its advantages and disadvantages. According to the parameters described the essay shows the following interdisciplinary profile:

	Epistemic Process	Assessment
1 st stage	Formulation of scientific question	Interdisciplinary planning
2 nd stage	Data collection	Mono-disciplinary performance
3 rd stage	Upgrading the data	Transdisciplinary amalgamation
4 th stage	Analysis of the data	Interdisciplinary evaluation
5 th stage	Conclusion with respect to scientific question	Interdisciplinary evaluation

0.4 Final Remark

It is a basic feature of all case studies in this volume that at the first epistemic stage a topic with an interdisciplinary perspective is formulated. However, in the subsequent epistemic stages interdisciplinarity is introduced and the stages are organised in a mono-disciplinary or transdisciplinary way. According to the epistemic strategies followed, three models can be distinguished:

The basically mono-disciplinary projects following the accumulation strategy reach the interdisciplinary level comparatively late, namely after the stage of analysis. However, during the stages of upgrading and data analysis, the future integration of disciplines is already focalised.

Projects following the *discourse strategy* usually enter the transdisciplinary exchange of ideas and partial results already at the stages of data collection and data upgrading. At the stages of analysis and conclusions, interdisciplinary recursive discourse is practised.

Projects following the *amalgamation strategy* more or less innovate and practise new scientific procedures already at the early levels of data collection or upgrading their empirical data.

The case studies of this volume try to provide a comprehensive picture of how the transdisciplinary collaboration within the *ACACIA Research Centre* was practised. The catalogue of structural elements and parameters concerning this collaboration under the aspect of interdisciplinary therefore is a structured account of what was done. It is by no means a comprehensive or finite code of what should be done in future transdisciplinary projects. Other forms of trans- or interdisciplinary collaboration are thinkable. We believe that the preconditions for the excellent functioning of the trans-methodological collaboration within the *ACACIA Research Centre* were:

- (1) The empirical orientation of all research projects;
- (2) The local orientation in more or less the same regions of Africa;
- (3) The coordinate timing of the research projects.

Under other conditions, different interdisciplinary strategies might have developed. Whether the composition of the collaborating disciplines and methods played a decisive role remains so far unproven, but there is enough relevant information to follow up this question in further studies.

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