



Traditional knowledge as an ethical fundamental for the conservation of biodiversity in the floodplains of the Amazon

Conhecimento tradicional como fundamento ético para a conservação da biodiversidade nas várzeas da Amazônia

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Resumo

Este artigo descreve e analisa componentes dos sistemas de gestão dos recursos naturais praticados por comunidades ribeirinhas, explorando os resultados de duas décadas de atividades de um projeto de pesquisa nas várzeas do estuário amazônico. A análise mostra que a dinâmica dos sistemas ribeirinhos estimula a sustentabilidade ecológica e proporciona uma base sólida para a subsistência das famílias. As comunidades ribeirinhas têm desenvolvido uma ética de conservação dos recursos naturais da várzea, resultando em formas de organização social caracterizadas pela equidade e pela ação coletiva. Essa ética tem potencial para se tornar ferramenta estratégica para a conservação dos ecossistemas de várzea na Amazônia, ameaçados pela exploração madeireira descontrolada e pelas intervenções de organizações externas que propõem modelos fortemente contrastantes de organização social. O desafio é assegurar e melhorar o contexto institucional das comunidades ribeirinhas, evitando enfraquecer a base do seu sistema socioambiental tradicional, o que requer ideias e estratégias inovadoras.

Palavras-chave

Riverine communities. Amazon floodplains. Sustainability. Natural resources.

Abstract

This article describes and analyzes components of natural resource management systems practiced by riverine communities. This paper is based on findings from research project that has been conducted in the floodplains of the Amazon's estuary. Data analysis confirms that the dynamics of river systems stimulates ecological sustainability and provides a solid foundation for the livelihood of families. Riverine communities have developed an ethic of conservation of natural resources of the floodplain based on the forms of social organization characterized by equality and by collective actions. This ethic has the potential of becoming a strategic tool for the conservation of wetland ecosystems in the Amazon, which is threatened by uncontrolled logging and by the interventions of external organizations that provide conflicting models of social organization. The challenge is to ensure and improve the institutional context of coastal communities, and to avoid a weakening of their traditional environmental system, which requires innovative ideas and strategies.

Keywords

Comunidades ribeirinhas. Várzeas amazônicas. Sustentabilidade. Recursos naturais.

INTRODUCTION

Varzeas are alluvial sedimentary formations in the Brazilian Amazon region that occur along the banks of white water rivers that have their origin in the Andes Mountains of Peru, Bolivia, Ecuador and Colombia (LIMA; TOURINHO; COSTA, 2001). These floodplains house the following two main forest types: (1) the daily flooded floodplain forest that is affected by maritime tides, and (2) the *igapó* forest that shows more permanent inundations with changing water levels. In the floodplain forest, palm trees, bamboos and grasses are abundant as well as several tree species of ecological and economic importance including virola (*Virola surinamensis*), pau-mulato (*Calicophyllum spruceanum*), andiroba (*Carapa guianensis*), rubber tree (*Hevea sp*), cocoa (*Theobroma cacao*), hogplum fruit (*Spondias lutea*), macacaúba (*Platymiscium felipes*), white-cedar (*Guarea guidonia*) and mututi (*Pterocarpus amazonica*). The *igapó* forest has more specialized vegetation, is poor in biomass and has a lower diversity of species. However, it has a lighter level of endemism. *Igapó* forests are important as nurseries and feeding grounds for many fish species.

When Europeans colonized the Amazon during the 17th and 18th centuries, the highly diverse ecosystems of those floodplains supplied European markets with a wide range of products known as *sertão* drugs that included cocoa (*Theobroma cacao*), sarsaparilla (*Smilax ornata*), copaiba oil (*Copaifera langsdorffii*) and guarana (*Paullinia cupana*). They also collected and commercialized bird feathers, and the skins of alligators, snakes and jaguars (TOCANTINS, 2000; REIS, 2001; PAZ, 2005). Since then, the commercial use of fauna and flora can be seen as the beginning of an era of systematic exploration of nature, although at this time exploitations occurred at a levels that allowed nature to recuperate. In their analysis of Brazilian history, Santos and Silveira (2001) named that phase the *First Period* in which nature still commanded human actions and the way of exploration.

This logic stands in sharp contrast to the manner in which natural resources are currently exploited for commercial purposes. This *institutionalization* of exploiting nature (SANTOS; SILVEIRA, 2001) within a general process of disorganized occupation and urbanization of the Amazon (IBGE, 2010) have provoked a significant depletion of biodiversity and severe cultural tensions between traditional inhabitants of the floodplains, the so-called *ribeirinhos*, and external actors entering the region to exploit land and other resources (BOTIA; TRUJILLO, 2010). Thus, the *varzea* has become a highly threatened ecosystem. This alarming situation is still supported by a continued neglect of customary

rights of the indigenous and traditional populations that contributed to the mistaken perception of unused resources that belong to no one.

Alarmed by the severe social and environmental consequences of this dynamic, the Brazilian government as well as many national and international movements started to discuss options for action from which numerous initiatives emerged, most of them targeting on the conservation of ecosystems and local cultures. Most importantly, such efforts included the demarcations of nature reserves and indigenous and traditional communities, as well as implementing numerous programs and projects that have sought environmental protection and sustainable uses of natural resources. The most prominent was a Pilot Program for the Protection of Rainforests (PPG-7) (MMA, 2009). More recently, the operational focus of these preservation approaches has switched to attempts for adapting to and integrating traditional communities into the global economy. This is perceived to be the most feasible approach to achieve economic growth and social well-being in the region (POKORNY et al., 2013). This, however, has resulted in partial successes. There is evidence that these approaches tend to accelerate social marginalization and environmental degradation (POKORNY, 2013).

Against this backdrop, this article intends to provide a deep insight into the ribeirinhos way of using natural resources. This is understood as the manifestation of a conservation ethic that is grounded in a long-standing process of co-evolution of man and nature. By exploring the findings of the research project VÁRZEA, this paper argues that only development approaches that build on such a conservation ethic can effectively contribute to the conservation of the Amazonian floodplain ecosystem. Since 1994, researchers from the Federal Rural University of Amazônia (UFRA) have been collaborating with researchers from the Federal University of Eastern Pará (UFOPA) and the Brazilian Organization for Agricultural Research (EMBRAPA) to conduct an in-depth study on the socio-environmental systems of production and land uses of riverine communities along the estuary of the Amazon River in the States of Amapá, Pará and Maranhão. The research particularly focused on community organization, production systems, land use, forest ecosystems, wildlife, animal husbandry, agroforestry and marketing of local products (GAMA; PALHA; SANTOS, 2009; LIMA; TOURINHO; COSTA, 2001).

In-order to develop the argument on the mutual linkage between culture and conservation of biodiversity, the next section sketches a theoretical foundation of a conservation ethic that follows an integrative understanding of socio-environmental systems. The section that follows discusses ethical fundamentals of conservation among riverine communities of the Amazonian floodplains.

The next section describes key components of natural resources management systems as practiced by the riverine communities. Subsequently, such systems are critically analyzed regarding their sustainability. Finally, we discuss the potential and limitations of such a conservation ethic to become the guiding approach for conservation.

1 THEORETICAL FOUNDATION OF CONSERVATION ETHICS

Conservation ethic is a concept that has drawn attention from several Western environmental groups (COLFER; BYRON, 2001). The term *conservation* leads to the idea of taking care to preserve and protect something important while *ethics*, in turn, can be regarded as a system of moral values that opposes a simple materialist perspective (ERC, 2003). Consequently, conservation ethic expresses a system of moral values that guide the use of a given resource in a manner that prevents its depletion by ensuring a harmonious relationship between humans and nature.

The theoretical foundation of such an ethic of conservation can be substantiated by the system theory as described by Ludwig Von Bertalanffy (2008) and Charles Loomis (1960). Both formulated their theories in the 1960s as a critic of reductionism, which still strongly prevails in science and that widely ignores the interdependence and interaction between man and nature. In their integrative view on socio-environmental systems, ethical production systems are perceived as a composition of interacting biological and social subsystems. Each of these subsystems is part of the whole and follows the common goals of maintenance, reproduction, feedback and stability. In accordance with this, ethics for nature conservation can be attributed to the core concepts of system theory including entropy, synchrony and resilience (CAMARGO, 2005; PEREIRA, 2009).

Embedded in such an integrative perspective on socio-environmental systems is the concept of socio-biodiversity, which calls for the exploration and management of nature by local inhabitant through locally developed practices in accordance with local interests, capacities and knowledge (TEISSERENC, 2010). From such an understanding of inseparably connected social and natural systems emerges the claim for political recognition of the value of traditional knowledge and cultural diversity as a basis for the conservation of nature (MOURA; CASTRO, 2012). The findings of the project VÁRZEA that focused on the culture and production systems of ribeirinhos are presented in the following sections in-order to defend the relevance of such a claim.

2 THE ORIGIN OF THE RIVERINE CONSERVATION ETHIC

The livelihood of ribeirinhos has always been closely linked to sustainable floodplain ecosystems (GERINGER; TOURINHO, 2009). Since early settlements of ribeirinhos, the environmental dynamic peculiar to Amazonian floodplains has necessitated a constant process of local families developing, adapting and optimizing their livelihood strategies and social organization (PEREIRA; WITKOSKI, 2012). The rivers with their dramatic changes in water flow of up to 14 meters resulting from the influence of maritime tides interplaying with the alternation of rainy and dry seasons throughout the year, thus, strongly influencing the communities' livelihoods (TOCANTINS, 2000; WITKOSKI; PEREIRA, 2012). In this sense, river flows influence trade, transport and the annual calendar of activities by setting the periods for recreation, fishing, hunting, agriculture and the extraction of timber and non-timber forest products (TOURINHO et al., 2009). In this context, building on the legacy of ancestral indigenous inhabitants of the floodplains has allowed ribeirinhos to become experienced and innovative managers of riverine ecosystems (GAMA; BENTES-GAMA, 2009). The vast repertoire of locally developed measures for the management of natural resources closely follows the determinants of nature and carefully considers its temporal and spatial specificities. The management systems primarily focuses on satisfying immediate consumption needs, and, more strategically, guaranteeing social reproduction of the families. Thus, land-use decisions are not influenced by profit maximization interests (COSTA, 2012). Compared to classic capitalistic production systems that are envisaged to the production of a few standardized products in constant qualities and quantities for global markets, the absence of a market economy allows riverine societies a great benefit of living in harmony with nature.

Over centuries, management of the Varzea by local communities has created a unique spatial and temporal mosaic of landscape features, which in turn has, in a co-evolutionary process, - further enriched the impressive diversity of agricultural, forestry and fishing activities that are present today. Co-evolution, in this sense, reflects an integrative understanding of socio-environmental systems, in which nature and social groups are interdependent, thus, mutually influencing the system's status.

At the heart of such processes is the communal social system, which is reflected by the manner in which members of such social system cooperate, compete, engage in conflicts accommodate and assimilate (TOURINHO, 2007; MELO JÚNIOR et al., 2013). While particularly cooperation and assimilation are

expected to generate forces acting against the entropy of socio-environmental systems, conflicting engagements and competition tend to provoke distortions. A study on of riverine communities revealed that forces functioning against entropy of socio-environmental systems primarily stem from local customs, habits and beliefs. Such forces become visible in settings of collective efforts such that include: (1) the production of cassava flour (*farinbadas*) (2) pulling fishing nets, (3) organization of religious festivities, and during the manufacturing of utensils and boats. These collective approaches serve as a solid foundation for the emergence of a conservation ethic that guided by respect and conservation of nature.

3 POLY-CULTURE FARMING SYSTEMS AN EXPRESSION OF A LOCAL CONSERVATION ETHIC

The aforementioned conservation ethic maintained by riverine communities is practiced in the poly-culture farming system. This is expressed by a unique relationship among households, markets and nature (TOURINHO, 1998; GERINGER; TOURINHO, 2009; TOURINHO et al., 2009). This farming system combines harvest of forest products with agricultural land uses for the cultivation of a large variety of grains, tubers, fruits and vegetables generally with slash and burn techniques. Although highly diverse, the system allows specializing in the cultivation of crops for subsistence. With this focus, crops such as corn, rice, banana, watermelon, squashes and beans normally account for more than 68% of the cultivated area (TOURINHO et al., 2009). Families decision on the specific size of the area to be cultivated takes into account criteria such as work force availability and soil fertility. Due to these criteria, the cultivated area seldom exceeds 1.5 ha per family (TOURINHO et al., 2009).

Livestock is another important component of the ribeirinhos production system (TOURINHO et al., 2009). Nearly every family is involved in the breeding of cattles and buffalos. Generally, the number of buffalos, approximately fifteen animals per household, is larger than the number of cattles, which seldomly exceed twelve heads per household. Animals are raised for both the production of beef for markets and of milk for subsistence. However, families that rear cattle have a greater commercial interest than those preferring to rear buffalos. Generally, each family develops up 2 ha of pasture lands, where canarana-erecta (*Echinochloa pyramidalis*), canarana-da-amazônia (*Echinochloa sp*), braquiarião (*Brachiaria spp.*) and braquiariinha (*Brachiaria spp*), colônia (*Brachiaria mutica*) and kikuyu (*Pennisetum clandestinum*) species are cultivated. Traditionally, the management is highly

extensive and does not include vaccination, nor mineral supplementation of herds.

Although agriculture and artisanal fishery are important components of the ribeirinho's livelihood strategy. However, little emphasis is placed on the extraction of forest products. Normally, forest products are harvested along rivers of varying lengths, but no longer than 1,000 meters. Families harvest several palm tree products, soft timber species such as virola (*Virola surinamensis*) and pau-mulato (*Calicophyllum spruceanum*), as well as non-timber forest products (NTFP) from andiroba (*Carapa guianensis*), rubber trees (*Hevea sp.*), cocoa bean (*Theobroma cacao*), hogplum fruit (*Spondias lutea*), macacaúba (*Platymiscium felipes*), white-cedar (*Guarea guidonia*) and mututi (*Pterocarpus amazonica*). The families tend to explore the existing diversity of forest products, which are extracted in low intensities. This observation is even more valid for the case of the "poorer" igapó forests. On average, a family explores only around 0.3 to 0.5 m³/ha/yr to satisfy their demand of timber for housing and boat making (RAMOS et al., 2007).

Finally, forest gardens are an essential aspect of the traditional riverine land use system. A forest garden is a highly diversified agroforestry system that is established near the house to produce food primarily for subsistence. Nevertheless, dwellers that have access to boats often sell surpluses in neighboring villages. Usually, the management of the gardens is performed by the women with the help of their children. Husbands and the elder children are only involved in activities that require more physical labour such as tree pruning and land preparation. The average size of a forest garden is less than 2,000 m². Cropping periods run for as long as approximately 25 years (BENTES-GAMA; GAMA; TOURINHO, 2009). The main tree species cultivated are virola (*Virola surinamensis*), andiroba (*Carapa guianensis*) and macacaúba (*Platymiscium felipes*), as well as a wide range of fruit trees, including biribá (*Rollinia mucosa*), guava (*Psidium guajava*), papaya (*Carica papaya*), cocoa (*Theobroma cacao*), cupuaçu (*Theobroma grandiflorum*), mango (*Mangifera indica*), lemon (*Citrus limonia*); and shrubs such as: banana (*Musa spp.*), chili (*Capsicum pendulum*), cubiu (*Solanum sessiliflorum*), jasmine (*Jasminum sp.*), cotton (*Gossypium herbaceum*), pião-branco (*Jatropha curcas*), rowan (*Couma sp.*), urucu (*Bixa orellana*) and elderberry (*Sambucus nigra*). The following herbs are also cultivated: basil (*Ocimum basilium L.*), chicory (*Umbeliferae sp.*), lemon balm (*Citrus spp.*), lemon grass (*Citrus limonia*), mucura-caá (*Petiveria alliacea*), ginger (*Zingiber officinalis*), amor-crescido (*Portulaca pilosa*), pirarucu (*Bryophyllum calycinum*), anador (*Justicia pectoralis*) and mastruz (*Chenopodium ambrosioides*). Despite this diversity of cultivated crops, the greater part of a forest garden is under assai (*Euterpe oleracea*) cultivation, given that it is a crucial element of the daily diet. Once the family decides on the site

to build a house, the surrounding area is cleaned to plant assai palm. Seedlings of assai are developed in small nurseries, or simply transplanted from natural forest regeneration. Families continue planting assai each year at the onset of the rainy season. Medicinal plants are also cultivated, in the gardens, where they are arranged in accordance to local beliefs and knowledge. Those species regarded as rare or difficult to obtain as well as those of high medicinal value are planted in the backyard in-order to protect the family against the evil forces.

4 THE SUSTAINABILITY OF RIVERINE LAND USES

The above-mentioned poly-culture farming system evolved in a long standing co-evolutionary process. But, to what degree such a management system can be considered as sustainable? This question is particularly relevant if considering the vulnerability of both the ecosystem as well as the social system. Floodplain ecosystems are extremely fragile and vulnerable to entropy processes due to periodic flooding and sedimentary replenishment (LIMA; TOURINHO; COSTA, 2001), while traditional societies increasingly suffer from disruptions and conflicts caused by powerful external actors interested in the communities' resources and continuously advancing agricultural frontiers and cultural systems of modern societies (ALSTON et al., 1999).

According to Pereira (2009), ecological sustainability of floodplain ecosystems is understood as their ability to allow efficient interaction between soils, forests, fauna, and water to ensure stable productivity of the exploited resources and resilience of the diverse ecosystem elements. Taking plant biomass production as an indicator for ecological productivity, inventories of the floodplain forests under management of riverine communities showed values of nearly 160t/ha (BARTELT; KOCH; TOURINHO, 2000; SANTOS; MIRANDA; TOURINHO, 2004), which is well above the estimates for the natural *terra firme* forests in the region (HOUGHTON et al., 2001). As it relates to species diversity, findings of vegetation sampling indicate a positive situation: sample survey was taken in varzea plots of the "igarapé" (creek) of "Lontra da Pedreira", in the state of Amapá. Thus, in 1 hectare of floodplain forest were found 112 forest species with predominance of 27,25% to assai palms (LIMA; TOURINHO; COSTA, 2001). As to the functionality of species for balance of the varzea ecosystem, the value of the carbon found in the dry biomass above the soil was considered as *proxy* of this equilibrium. Research data on this subject carried out in the Tocantins river, near of Cameté city, in the state of Pará, show that of a total of 19 species, 9 were responsible for 90,4% of the carbon stock, and the plants like

Virola surinamensis and *Hevea brasiliensis*, account for 55,4% of the total carbon stock (SANTOS, 2016). Even highly sensitive forest species such as *Eucylophora paraensis*, *Cedrela odorata* and *Virola surinamensi* have been found in considerable abundance in the intensively harvested forests. Findings suggest that the manner in which the communities use their forest resources does not deteriorate forest ecosystems. The low intensity of extraction of a large diversity of forest species does not only guarantee the natural regeneration of the floodplain flora, but also facilitate dispersal of seeds by water moving across the banks of the floodplains. This also facilitates the processes of syntropy as a response from the ecosystem for immediate regeneration. These evidences confirm the sustainability of local forest harvesting practices, particularly considering the fact that occupation and systematic exploitation of resources from these areas have begun approximately 400 years ago. Findings even suggest that the ‘ribeirinhos’ harvesting practices have strengthened the resilience of the floodplain ecosystems (PEREIRA, 2009).

The studies conducted within the scope of the VÁRZEA project also revealed that the manifold small-scale agriculture, extractive and breeding practices, although primarily established by the families for production purposes, guarantees important ecological functions, thus contributing to the long-term conservation of the floodplain ecosystems. For example, deep rooting plants such as rubber (*Hevea sp.*), jambo (*Syzygium jambos*), mango (*Mangifera indica*) and hogplum fruit (*Spondias lutea*) protect the bank of rivers and “igarapés” (creeks) against soil erosion (LIMA; TOURINHO; COSTA, 2001). Also the small slash and burn fields for agriculture are far from compromising the systems’ biological capacity, even more considering that the management relies on simple technologies with a low level of environmental impact. Instead, particularly in the case of fallow periods, which lasts for in excess of three years, a wide range of weeds grow on the fields that strengthening the ecosystem’s resilience (SCHUMACHER, 1979). According to Lima et al. (2001), in the floodplains ecosystem the phenomena pass in a different way. The destruction of the organic matter during the burning takes place with less intensity. Humus and the remaining organic debris from the burning compel to retain the salts in the ash. On the other hand, the colloidal complex of the clay of floodplains also exerts a predominant action in the fixation and retention of these nutrients and of the mineral salts contained in the ash of the combustion of the trees.

The preservation of endogenous animal species such as Owls for syncretic reasons and the multiple use of plant species such as sororoca (*Ravenala guianensis*), which is widely used for packaging of assai in baskets made of cipó-ambé (*Philodendron fragrantissimum*), are also examples. These processes are further

facilitated by practices such as the maintenance of ant nests acting as sentinels against insects that may negatively affect agricultural crops. Such practices are present among cocoa small farmers: they use to disseminate nests of caçarema ant (*Azteca chatifex spiriti*) in the cocoa plantation to protect the new cocoa fruits from predatory insects (COSTA; FRAZÃO, 1973; DELABIE, 1989). Even the local pasture management practices allows co-existence of many natural grassland species, and the absence of vaccination and mineralization support adaptation of animals in direct relation to local environmental conditions (PEREIRA, 2009).

As it relates to the socio-economic dimension of sustainability, the studies confirmed a favorable trend (TOURINHO et al., 2009). Taking equity as a key indicator of sustainability (COLFER et al., 2000) riverine societies can be considered as well-developed. In the communities studied, the distribution of land tenure according to the Gini coefficient was approximately 0.4 indicating nearly full equality, although, as in other societies, the process of appropriation of water, land, flora and fauna also in the riverine communities has been subjected to competition and conflicts. With 0.2, the Gini coefficient for income was even more equal, which confirms that resources, costs and benefits in riverine communities are very well distributed between families.

Ambivalent, however, have been the results regarding some classic indicators for economic well-being. Riverine communities show some of the lowest income values for Brazil (IBGE, 2010), which however is typical for subsistence-oriented societies. While around 70% of income still stem from agriculture and extractive activities, off-farm activities and social benefits are assuming an increasing role, particularly among youths (DIEESE, 2011). Overall, the analysis indicates a stable long-term economic basis as the household incomes show moderate, but continuous growth (PEREIRA; 2009). However, more critical than income is the dilemma of very limited access to public services, particularly in the health sector (MURRAY; SÁNCHEZ-CHOY, 2011). Insufficient protection of customary rights on land and resources used by these communities can be deemed as a sustainability threat (ALSTON; LIBECAP; SCHNEIDER, 1996).

FINAL CONSIDERATIONS

There is an increasing recognition regarding the fundamental importance of cultural diversity for the sustainability of highly endangered forest ecosystems in the tropics (POSEY, 1999; MAFFI, 2001; PRETTY et al., 2009). The findings from the research project VÁRZEA reinforce this argument. In a historical process of co-evolution, traditional riverine communities in the Amazon's

floodplains have developed a conservation ethic that manifests in a specific form of social organization characterized by equity and collective action, as well as a poly-cultural farming system that effectively uses the diversity of natural resources (ALTIERE; MASERA, 1997 apud PEREIRA, 2009). This socio-environmental system guarantees and even stimulates ecological sustainability while guaranteeing a sustainable livelihood basis for the families. Consequently, the conservation ethic of ribeirinhos has the potential to become a strategic tool for environmental conservation.

However, stakeholders with economic interests in the abundant resources of the floodplain forests pose a threat to this socio-environmental system. Uncontrolled exploitations of high-value tree species by logging companies have already severely impacted the fragile varzea ecosystems (LIMA; TOURINHO; COSTA, 2001). Simultaneously, inappropriate interventions by governmental, non-governmental organizations and private companies, which propose models of social organization, which that strongly contradict with the riverine population's cultural system, have provoked conflicts that seriously affected and even partially abolished the riverine ethic of nature (TOURINHO, 2007).

Considering the modest success of purely economic and regulatory approaches for protecting and conserving nature (PRETTY et al., 2009), traditional schemes of organization and production that follow traditional rules and institutions present an alternative for more effective conservation (WALDMAN, 2006; REIS; ALMEIDA, 2012). Such an alternative approach deems even more relevant in the light of the fact that the environmental and social diversity of the Amazon region is commonly perceived as the most significant contribution of the Amazon to society (MEA, 2002). Some authors even stated that any effort for saving biological diversity, must concomitantly safeguard cultural diversity (PRETTY et al., 2009.) Such an approach necessitates an explicit local perspective that respects local capacities and interests while opposing external interferences (GASCHE, 2012). Securing and improving the institutional context for riverine communities while carefully avoiding a weakening of the basis of their socio-environmental system remains a challenge and requires innovative ideas and strategies that are consistent with the local cultural system, and not premised on Eurocentric development models.

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