

# **Frontier Migration as response to environmental change**

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**a case study from Central Sulawesi, Indonesia**

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### **Abstract**

Environmental change and climate variability in rural regions of developing countries can lead to serious consequences. The effects are regarded as major threats to household incomes and therefore as main push factors influencing migration. The paper seeks to identify the livelihood strategies, which are employed as a response to climate change. This research is based on a qualitative approach by applying different methods such as semi-structured interviews and PRA-sessions. We find that environmental change, population growth and unequal land distribution induces migration to the forest frontier. Land shortage and high land prices in the regions of origin and cheap access to land in the destination areas are the classical driving forces for migration in the region. But, if the household income is reduced by environmental hazards on the local level, some households choose to migrate.

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## **Keywords:**

**Rural migration, environmental change, Indonesia**

## 1. Introduction

The Intergovernmental Panel on Climate Change (IPCC 2007:46-50) alerts that, due to increased human-induced environmental changes and climate change impacts, drought-prone areas are on the fore-run, especially in developing countries. These areas are already by now seriously affected by ever-increasing water scarcity and shrinking yields. In many of these areas, an unsustainable use of natural resources has led to environmental disturbances and to a decline of ecosystem services. Beyond that, future environmental changes as a result of increased greenhouse gas emissions will further exacerbate the subsistence of the rural poor.

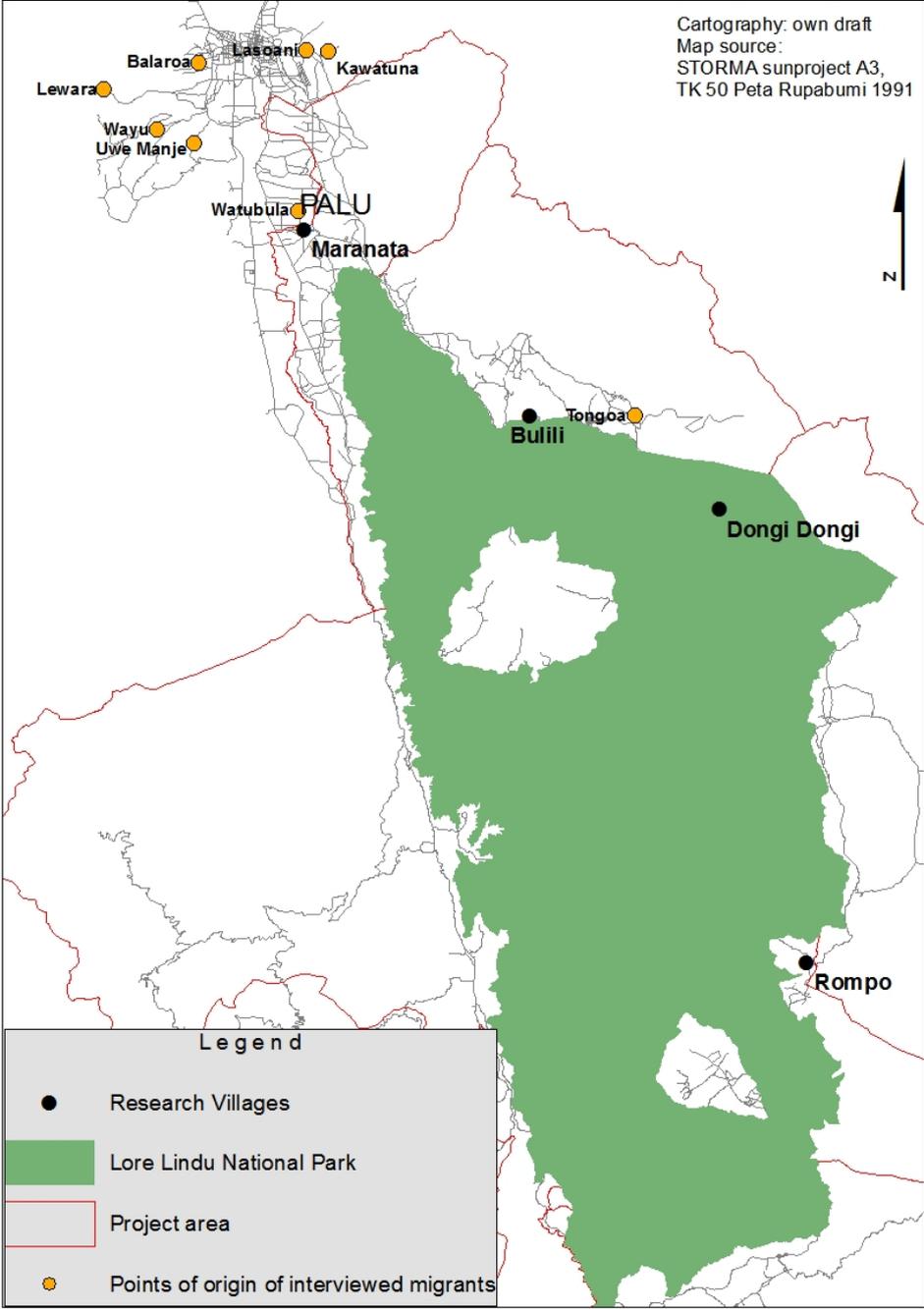
One possible adaptation strategy to environmental change can be permanent or temporary out-migration. According to the Internal Displacement Monitoring Centre (2009), environmental and climate factors are already inducing migratory movements. In 2008, more than 20 million people left their homes due to the occurrence of extreme or abrupt environmental changes.

This paper will clarify in a case study whether environmental change is affecting livelihoods and is inducing migration in rural regions of Central Sulawesi. The approach is based on the following research questions:

- What are the main motivating forces for migrants to leave their previous living place? Did they migrate because of environmental factors? And, if so, did they try other coping or adaptation strategies before they moved?
- Which coping or adaptation strategies to environmental change instead of out-migration are used in the face of environmental changes in potential migrant sending areas?

The research area upon which this paper is based is the Lore Lindu region which is located in the east of Indonesia, on the island of Sulawesi. The area encompasses the Lore Lindu National Park south of Palu, the provincial capital of Central Sulawesi. This area is highly diverse, both in socioeconomic and in ecological terms: the area is a part of the Wallacea Biodiversity Hotspot which, in terms of bird endemism, is second only to the tropical Andes (Conservation International 2007). The Palu Valley is one of the driest Equator-near regions of the world. The average annual precipitation measured at Palu Airport amounts to 616mm, while the surrounding mountains of the National Park are receiving up to 3000mm rainfall per year. According to Keil (2004, 2008, 2009), more frequent ENSO (El Nino and the Southern Oscillation) cycles and an increased drought frequency due to deforestation (Metzner 1981) are already affecting the livelihoods of rural households in the area. Beyond environmental

hazard issues, the area has experienced a cocoa boom resulting in deforestation and land scarcity, which provokes migratory movements and further deforestation as well as increased land scarcity (cf. Ruf et al. 1995; Li 2002; Faust et al. 2003, Clough et al. 2009).



**Figure 1: Map of project area**

The research is based on a qualitative approach. During a four months field-trip from October 2008 to January 2009, semi-structured interviews and focus group discussions were

conducted in four villages surrounding the Lore Lindu National Park (Fig. 1 map of the research region). The four villages Maranata, Bulili, Rompo and Dongi Dongi are going to be introduced in detail in section 5.1.

The article proceeds as follows: the second section deals with deforestation induced environmental change and with climate change impacts on the research area. The section outlines consequences of deforestation theoretically and describes deforestation dynamics and its consequences for the Lore Lindu Region. The third section overviews the conceptual framework of this paper and theoretical assumptions about rural migration in the face of environmental change. Section four describes the qualitative approach used for this paper. In section five the results of the household interviews and participatory rural appraisal sessions are outlined. Section six deals with the main results, answers the research questions, and analyzes the results in regard to the theoretical assumptions outlined in section three.

## **2. Deforestation-induced environmental change and impacts of climate change**

As a matter of fact, the global environment has been changing throughout history. An illustrative example is rock painting in the Algerian Sahara which shows humans hunting elephants in a green wet savannah environment where today one finds a dry desert (Beniston 2004). However, the new and severe aspect of recent environmental change is the velocity under which changes occur. According to the Millennium Ecosystem Assessment Report (2005), the rate of ecosystem change has increased significantly over the last fifty years. Today, more than 60 percent of the world's ecosystems have been degraded as a consequence of both intended and unintended human action. Important drivers for environmental degradation are: deforestation, overexploitation of natural resources, intensive agricultural production and anthropogenic-induced climate change.

In the study region, just as in other parts of the tropics, deforestation and its consequences pose a threat to the livelihoods of rural people. Deforestation leads to higher flood risks, erosion, soil degradation, and to a higher drought frequency. Despite of their apparent contrariness, droughts and floods are often related events (Suhrke 1994; Bradshaw et al. 2007, Binternagel et al. 2010). Deforestation and degraded soils are leading to an increased runoff and faster runoff speed which is associated with higher flood risks. In addition, degraded soils have a lower water storage capacity than intact forest soils. This results in water scarcity in

virtually humid areas. At the same time, deforestation leads to reduced rainfall on a regional scale because of two factors: The first factor is that trees are producing water vapour through evapotranspiration; hence, they are contributing to the local hydrological cycle (Laurance/ Williamson 2001). Consequently, fewer trees lead to less evapotranspiration and to less water vapour in the local climate system (ibid.). A study conducted in the Brazilian Amazon region shows that large scale deforestation causes a 26 percent decline in Amazonian overall precipitation and a surface temperature increase by 1° to 3° (Shukla et al. 1990: 1324). The second factor is that deforestation leads to an enhanced risk of forest fires: Smoke can trap moisture and inhibits the formation of clouds and raindrops (Laurance/ Williamson 2001).

In the research area, annual deforestation rate between 1972-2002 amounts to about 0.6 percent per year, which is significantly lower than the Indonesian average (Erasmi et al. 2004; FAO 2006). Recently, deforestation has been increasing, in particular inside the Lore Lindu National Park. During 1999-2002, nine percent of the forest cover inside the national park got lost (Erasmi et al. 2004; Seeberg-Elverfeld 2008). According to Metzner (1981), deforestation on the slopes of Palu Valley is already associated with higher temperatures and dryer conditions and with water scarcity endangering the cultivation of wet rice in the valley. As a result of contradictory governmental policies (promoting wet rice cultivation and allowing the destruction of forest in watersheds), deforestation in the Gumbasa river water shed reduces the irrigation capacity significantly. According to Whitten et al. (2001: 441) a timber concession in the Gumbasa catchment was granted to a logging company in 1978 and further illegal logging led to soil erosion which regularly led to blocked irrigation channels. According to Leemhuis (2005: 122) deforestation is leading to increased discharge variability in the Gumbasa and Palu River catchments.

Following the third assessment report of the Intergovernmental Panel on Climate Change (IPCC 2007), the world's surface temperature increased by 1° over the last century. In Southeast Asia, surface temperature rose already by 0.3° while, for Indonesia, a further increase by up to 0.9° until 2039 has been predicted (Cruz et al. 2007). It is likely that these changes of surface temperature are responsible for observed extreme events like droughts, heat waves and storms in the region. Against this background, Case et al (2007) are projecting a decrease of total annual rainfall for Sulawesi and an increase of the seasonal rainfall variability. According to a paper prepared by DFID, the World Bank, and Indonesia's State Ministry of Environment, Indonesia's food security will be threatened by climate change.

Crop yields—in particular soybean and corn—are likely to decrease by up to 50% (PEACE 2007).

Alongside to climate change and deforestation issues, the ENSO (El Niño/ Southern Oscillation) phenomenon is influencing the atmospheric conditions in the Lore Lindu Region, just as in the whole Pacific region. ENSO contributes to prolonged droughts in Southeast Asia and to more humid conditions in parts of South America. Over the last third of the 20<sup>th</sup> century, a sharp increase of dry ENSO periods was observed (NOAA 2009). Yet it is unclear in how far this is caused by anthropogenic-induced climate change. Some scholars have pointed that prolonged and more intense ENSO cycles due to climate change are likely to occur (cf. IPCC 2001).

### **3. Rural migration and adaptation – Theoretical Framework**

The paper deals with subjective, or individual, causes of migration. Therefore migration is regarded as a complex social phenomenon and not as a direct response to environmental resource degradation. However, environmental change and climate variability are regarded as some of the most important threats to household income (Reuveny 2005, 2007; Klot 2004). Migration is an indicator for the breaking up of resilience and, in this vein, as an active strategy to enhance the resilience<sup>1</sup> and to reduce the vulnerability of households (Adger 2000).

In general, most of the theoretical literature on the environmental change-migration nexus distinguishes between different reasons for migration. Leimgruber (2004:255), for example, distinguishes between natural disaster “*beyond human control*” and “*natural processes as unintended consequences of human actions*”. Lonergan (1998) differentiates between natural disasters which can provoke ad-hoc migration and long-term environmental change or destruction like forest clearance, soil degradation or global warming. Other scholars distinguish between forced migration as a consequence of abrupt environmental change and voluntary migration as a consequence of a declining natural resource base or economic decline (Suhrke 1994). The migration continuum approach from Hugo (1996: 108) considers that in most cases even for the migrants themselves it is not easy to declare their respective migration as forced or voluntary. Classical push- and pull approaches within the theoretical

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<sup>1</sup> According to Adger et al (2005: 1037) „Resilience reflects the degree to which a complex adaptive system is capable of self organization (versus lack of organization or organization forced by external factors) and the degree to which the system can build capacity for learning and adaptation”.

framework of migration theory are based on the assumption that different types of harassment (Nuscheler 2004: 102) or lower wages in the regions of origin act as push-factors while higher wages and better livelihoods in host regions serve as pull-factors for migration dynamics (Lee 1966; Todaro 1969). Harassment, in this context, then consists of ecological degradation, natural disasters or economic or political factors (De Haan 1999; Kliot 2004; Leimgruber 2004.). Furthermore, decreasing agricultural yields as a result of environmental change are perceived as livelihood threats. Following Lee (1966), *personal factors* for migratory movements are rather subjective than determined by objective factors such as wage differentials.

In the face of environmental change occurrences, a household or an individual may choose to migrate permanently or temporarily. Another option is migration of household members for income diversification. This type of migration is conceptualized by the *New Economic of Labour Migration* (NELM) developed by Stark and Bloom (1985). According to the NELM-approach, rural households would rather put their focus on aspects of risk reduction than on income maximization. Migrating household members rely on informal contractual arrangements and are supporting each other, thus remittances from those members can compensate income shortfalls due to natural disasters or economic shocks. Remittances may reduce the vulnerability of households and enhance their resilience (Black et al. 2008).

Despite the fact that in many developing countries migration mostly occurs intra-rural (and not rural-urban) (Carr 2009: 2), theoretical approaches to illuminate those migratory movements are only fragmentarily existent. Push- and pull approaches or NELM can be applied for analyzing rural to rural migration (Doevenspeck 2005). Yet, migrants living and moving in a rural context may emphasize other factors for explaining their personal and individual reasons for migration than rural to urban or international migrants. While educational achievements are regarded as key factors for successful international migration and urban immigration, Carr (2009) assumes that rural frontier migrants are generally less educated than non-migrants. Also in rural settings, social networks are according to Brown (1985: 417) very important. Due to worse access to formal information flows in rural areas, kin and friendship networks are the most common information sources.

Rural migratory movements are rather focused on the availability of land resources than on employment opportunities. However, empirical evidence has shown that access to off-farm employment also contributes to lower migration pressure. In particular, people holding marginal land resources only, may not migrate if there is a chance to compensate livelihoods

from their insufficient land resources with additional off-farm income (Brown 1985; Billsborrow et al. 1990). In tropical countries rural to rural migration is often directed towards the forest frontier (e.g. Brazil, Indonesia). The forest frontier, or agricultural frontier, is defined as the dynamic edge of the rural settlement area (Doevenspeck 2005). At least in the first years after forest conversion the forest frontier combines virtually open access to land resources and high soil fertility, (Carr 2009). Thus, deforestation is often linked to frontier migration and agricultural expansions at the forest margins (cf. Faust et al. 2003). Unsustainable land-use practices have a negative impact on ecosystem services. A consequence is that frontier migrants that moved due to environmental change have to cope with the same occurrences at their respective destination on the forest margins than before and probably have to move again (Billsborrow et al. 1990; Amacher et al. 1998; Hugo 2008). Furthermore the agricultural frontier is often associated with disputes over land and between spontaneous immigrants, indigenous groups and conservancy agencies (Acciaioli 2001; Li 2002; Sitorus 2002).

A central thesis of this paper is that households try to adapt in place before they move (c.f. Meze-Hausken 2000). The concept of adaptation or adaptation strategy is central in this framework. Following Smit and Wandel, adaptation “*usually refers to a process, action or outcome in a system (household, community, group [...]) in order for the system to better cope with, manage or adjust to some changing condition, stress, hazard or opportunity*” (2006: 282). In this paper, the term *adaptation* describes long-term strategies to manage the impact of environmental change occurrences and strategies which may anticipate the impact of extreme events. For short-term strategies in the face of a natural disaster this paper employs the term *coping strategies*. Whether migration to the forest frontier is a solution for affected households depends on the *adaptation capacity* of the household or the community towards natural hazards (Adger 2000; Wood 2001; Renaud 2006). The term *adaptation capacity* is context-specific and depends on the social and economic asset base of the household and their members. Social assets like kinship ties or economic assets like access to credits or irrigation facilities may increase the adaptation capacity. Thus, natural hazards do not automatically induce out-migration (cf. Wood 2001).

## **4. Methods**

During a three months period, from October 2008 to January 2009, 44 semi-structured household interviews, participatory observations and participatory rural appraisal sessions (PRA) with local elites have been conducted in four villages surrounding the Lore-Lindu National Park. Three villages were selected by using data from a quantitative village census accomplished by the STORMA research project in 2004 and from further qualitative research done by Weber and Faust (2005) and by Binternagel et al. (2010). The fourth village was chosen after conducting a preliminary analysis of the interview data. According to the research foci migrants and non-migrants having experienced natural hazard were interviewed.

The semi-structured interviews dealt with the migration history of the households, with livelihood strategies and livelihood assets in regions of origin and their individual factors influencing their respective migration decision. The non-migrant household heads were mainly interviewed about their strategies in the face of environmental change and about their broader socio-economic situation. In addition to semi-structured interviews with household heads, two participatory rural appraisal sessions with local elites such as Kepala Desas, Kepala Dusuns<sup>2</sup> and local traders were conducted in the village of Maranata. The PRA sessions dealt with droughts and were conducted to gain information about coping and adaptation strategies used in the village.

## **5. Results**

### **5.1 The villages**

Maranata is a former resettlement village in the dry Palu Valley. The village was founded in the 1970s. Since 1980, the village has access to the Gumbasa Irrigation System (Bendung Irrigasi Gumbasa). Former inhabitants of the mountain ranges south of the provincial capital Palu, predominantly Kaili Da'a, were resettled, first in order to stop slash and burn agriculture, and second to promote wet rice cultivation. Maranata has been recently affected by out-migration, in particular to more humid areas in which cocoa cultivation is more profitable. The three other villages represent different stages of recent forest frontier colonization. Bulili is a village established in the 1980s by spontaneous immigrants at the margins of the Lore Lindu National Park. The first immigrants were Bugis and Kailis mostly from Palu Valley.

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<sup>2</sup> Kepala Desa: Village chief, Kepala Dusun: Chief of village section

**Table 1: Survey villages (Source: BPS 2006a, 2006b, 2007)**

Survey villages	Maranata Emigr.	Rompo Immigr.	Bulili Immigr.	Dongi-Dongi Immigr.
<b>Population</b>	2453	443	1555	k. A.
<b>Village area (km<sup>2</sup>)</b>	8,65	67,66	7,35	k. A.
<b>Density (population/ km<sup>2</sup>)</b>	284	6,5	211	k. A.
<b>Number of <i>Dusun</i><sup>3</sup></b>	5	2	5	4
<b>Number of households</b>	986	115	331	1030 <sup>4</sup> / 2000 <sup>5</sup>
<b>Highest school in village</b>	SMP <sup>6</sup>	SMP	SD <sup>7</sup>	No official school
<b>Main crops</b>	wet rice, vegetables, corn	cocoa, corn, wet rice	cocoa	cocoa, vegetable, corn
<b>Mobile coverage</b>	since 2007	no coverage	since 2008	no coverage

Since 1990 the village population has increased significantly due to the cocoa boom. The third research village, Rompo, lies on the south eastern frontier of the national park. Apart from immigration from the Napu and Palolo Valleys, the village achieves a significant increase of population because of a privately initiated resettlement scheme conducted in 2000. Predominantly Toraja, an ethnic group from the northern parts of South Sulawesi, have been resettled to the village. Dongi Dongi, the fourth village, is one of the most popular destinations for recent forest-frontier migrants. The village is an informal settlement inside the Lore Lindu National Park. It was established in 2002, in particular from landless migrants from Palu and Palolo Valley. After conflicts with the national park authorities and the provincial governments, the settlement has now an informal school and several churches and

<sup>3</sup> Dusun: administrative unit of a village headed by the Kepela Dusun, the elected village section chief.

<sup>4</sup> According to the NGO Yayasan Tanah Merdeka 1030 families lived in the settlement in 2001, web link: [http://ytm.or.id/v2/index.php?option=com\\_content&task=view&id=49&Itemid=44](http://ytm.or.id/v2/index.php?option=com_content&task=view&id=49&Itemid=44) (accessed 09.09.2009).

<sup>5</sup> According to a local more than ca. 2000 households are living in the settlement now.

<sup>6</sup> SMP: Sekolah menengah pertama, similar to junior high school, from class 7 to 9

<sup>7</sup> SD: Sekolah dasar, similar to elementary school, from class 1 to 6

mosques and will probably be accepted as an official village by local authorities shortly. Table 1 provides an overview about some key facts of the villages such as population, land-use and others.

## **5.2 Livelihoods and environmental change in migrants regions of origin**

Environmental change as a threat to livelihood was stated in particular by households which lived south of the provincial capital Palu, in the arid and semiarid Palu Valley. Rain fed agricultural production in the Palu Valley is highly insecure and is associated with fluctuating agricultural incomes. In addition to the already critical ecological conditions for agricultural production, some farmers complained about declining precipitation due to increased deforestation. As a result, even during the rainy season rain fed agriculture (corn, peanuts, and cassava) was often not successful.

Amplified through the establishment of the Gumbasa irrigation system in the 1970's and next to the perennial water courses of the valley, farmers are growing wet rice. Wet rice farmers are increasingly exposed now to declining over all water resources which disarranged the irrigation schedule. Declining water resources are probably associated with declining water yields as a result of deforestation. Moreover, wet rice farmers have to cope with landslides which destroyed the main irrigation channels and which have been leading repeatedly to a total breakdown of the public irrigation system for several months. In 1987, 1997 and 2000 due to ENSO-related droughts, and in 2005, due to a landslide, the public irrigation system operated not sufficiently well for wet rice cultivation. In general, wet-rice cultivation is not very drought-tolerant. According to the interviewed households, the total breakdown of the irrigation system in 2005 led to crop failure, and even more drought resistant crops like peanuts or cassava did not generate adequate income.

In addition to drought-related risks, farmers cultivating wet rice in flood plains were affected by inundations during the rainy seasons. Farmers cultivating annual crops on steep slopes were faced with landslides which destroyed their agricultural crops. Beside the risks already mentioned, declining soil fertility jeopardized the income of agricultural households.

For rural households, land scarcity and high land prices are issues of special concern. Interviewees from those households living in resettlement schemes such as Kamarora, Maranata and Rahmat stated that their land resources have not been sufficient for supporting the whole household. Moreover, they could not gain sufficient non-agricultural income to expand their plots. The households claimed that resettlement programs implemented in the

1960s and 1970s were poorly managed and are the main cause for land scarcity in the resettlement villages. Household members stated that in general every resettled household obtained 2 ha land for agricultural use. In many cases, the participating members received less than 1ha land, those resettled after 1973 even less than 0,5ha. Moreover, some migrants stated that they owned plots with high slopes or with very insufficient access to irrigation systems. They mentioned that their crops withered before those of their neighbours which had flat plots or better access to irrigation systems. Farmers who did not own land and who only leased plots often stated that most of the plots they could lease were difficult to farm due to high slope, insufficient soil fertility or insufficient access to irrigation. In summary the most important features for characterizing the livelihoods of interviewees in regions of origin are fluctuating agricultural incomes due to droughts or unstable irrigation and land scarcity.

### **5.3 Coping and adaptation in the face of environmental change in regions of origin**

Prior to migration households have been using various strategies like land-use change and earning additional income by working as day labourer in the construction or in the agricultural sector. Households attempt to adapt with environmental change. A very frequently used coping strategy is to reduce household's expenditures. Households took two meals a day instead of three or they tried to consume self produced or cheaper food such as cassava and corn instead of rice. Some households sold their livestock due to drought related income deficiencies. In this context livestock can be regarded as an "assurance system" that is used in the face of crop failure. Other households stated that they took small loans from local traders to cope with temporary income lacks. A problematic strategy to cope with drought induced income shortages is the disposal of assets which are essential for agricultural production. During the strong ENSO drought related in 1997 some households were forced to sell plots to overcome the income crisis.

Off-farm<sup>8</sup> income as a type of adaptation may contribute to more diverse income portfolios and probably to a higher stage of resilience. Households tried to gain additional income in case of drought related income deficiencies on the rural labour market to ameliorate their household income. There are two popular off-farm employment opportunities in the regions of origin: working as an agricultural day labourer and working as a construction worker. Households which gain additional income from off-farm employment in the agricultural

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<sup>8</sup> Babatunde (2009) defines off-farm income as all income which is not gained on the own farm, including income gained in the agricultural sector.

sector, for example as day labourers on *sawah*<sup>9</sup> plots stated that during droughts or in the case of a breakdown of the irrigation systems they had difficulties to find employment opportunities. As a consequence, some household members (predominantly male ones) tried to migrate temporarily within the study region or sought additional income on cocoa plots. A few households relied on income gained through the migration of family members to urban regional centres such as Palu, Poso, or Gorontalo. In the majority of cases, they worked in the urban construction or transport sector. Rural households from the northern part of the Palu Valley had to cope with a highly insecure precipitation regime which leads to permanent income insecurity. For most of them, additional off-farm income gained on the urban labour market of the provincial capital Palu was a permanent and an essential income source.

Land use change as an anticipatory or as a successive response to drought could be regarded as a popular household strategy for migrant households prior to their respective out-migration. Households practicing rain fed agriculture have been growing more drought resistant crops like peanuts, cassava, red beans and potatoes instead of corn. Farmers growing irrigated wet rice tried to plant peanuts, chilli, and corn during irrigation shortfalls. In addition many migrant households relied on forest products at their previous place of residence. Household members collected rattan for sale, rattan leaves, heart of palms, and hunted game for own consumption.

In general most of the described strategies did not help the later migrants to establish a sustainable household income or to invest in larger agricultural plots. Summing up, the most popular strategies to cope with environmental change were off-farm employment, reduction of household expenditures and cultivation of drought tolerant crops.

## **5.4 Causes and pattern of migration in the Lore Lindu Region**

### **5.4.1 Individual push-factors**

Migrants from all over the study region stated that the cultivable land of their parents was not sufficient and their parents were not able to endow them with enough land to support the foundation of an own household. Furthermore, the migrants mentioned that land prices at their place of birth were too high to buy additional plots. Migrants from northern Palu Valley declared that they left because of the high precipitation variability which led to high income insecurity. Moreover, it was difficult for them to find off-income opportunities on the near

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<sup>9</sup> Indonesian word for wet rice agriculture

urban labour market of Palu. Hence they left their villages because both income pillars were insufficient.

Farmers who left villages with access to the public irrigation system Gumbasa stated that the irrigation system operates not adequate and that without irrigation wet rice production was nearly impossible. In addition, a number of migrants proclaimed that they wanted to grow cocoa instead of *palawija*<sup>10</sup> or wet rice. The research region experienced a unique cocoa boom which induced migratory movements, in particular to the forest frontier (Ruf et al. 1995, Clough et al. 2009). Migrants living in villages supplied by the Gumbasa irrigation system stated that - due to government regulations - they were not allowed to grow cocoa while using the water from the public irrigation system. Migrants from Palu Valley without irrigable land referred to the critical climate conditions for cocoa production in their villages. Former inhabitants of the slopes surrounding the Palu Valley declared that the soils were not fertile enough for cocoa cultivation. One migrant explained that his cocoa shrubs did not blossom after five years (according to one migrant, cocoa shrub could blossom after three years under normal conditions and under ideal conditions after two years) and that even his coffee shrubs did not grow well.

Apart from the critical soil fertility for agro forest systems (cocoa/ coffee) migrants stated that due to deforestation the area was getting drier and the *palawija* was getting difficult and insecure. Furthermore migrants mentioned that because of the high slope rate a permanent cultivation of their plots was almost impossible. Other causes for migration, in particular for those from peripheral mountainous areas, were bad access to roads and markets. Migrants stated that their previous villages did not have access to drivable roads. They could only reach markets by walk. This in many cases implied a hike for more than one day. In addition to the infrastructural problems, off-farm employment opportunities were even worse than in the valley.

Summing up, the main drivers for migration in the region have been land shortage, the cocoa boom, and high land prices in regions of origin and free or cheap access to land in destination areas. But environmental change events, especially droughts and to a lesser extend floods and landslides, did also have an impact on household incomes in the villages and provoked migration. Environment- induced migration decisions have been taken mostly from

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<sup>10</sup> Indonesian word for crops such as corn, peanuts, and cassava.

households of the northern Palu Valley region, while primarily economy-induced decisions had been taken from migrants from outside Central Sulawesi and from Palolo-Valley.

#### **5.4.2 Individual pull-factors of migrant destination areas**

Pull-Factors are those characteristics of migrant's destination areas which were denoted as attractive by the interviewed migrants. In general, the interviewed migrants stated that the crucial factor for choosing their migration decision was free or cheap access to land resources in destination areas or higher wages in the agricultural sector. Most of the migrants already had social ties to their respective destination. Friendship or kinship ties helped them to gain knowledge about potential destination areas. Moreover, friends or family members supported the migrants after their arrival. Family members often sold or leased them land or assisted them in buying land from other community members, or helped them to find positions as day labourers. Before migrants decided to stay permanently they often worked as day labourers on cocoa plantations, or collected rattan or other forest products in the surrounding woodland. During their working-stay they got in contact with locals, earned money for financing the relocation, and gained knowledge about the ecological conditions and cocoa cultivation and its potential high earnings. Some migrants added that locals paid them with land instead of daily regular wages.

In particular for migrants from Palu Valley and its slopes, the soil fertility, the humid conditions and the good accessibility of the destination villages are very attractive. Migrants stated that they heard that in Dongi Dongi and Bulili cocoa shrubs could blossom after two years and coffee shrubs could blossom after one year. They also mentioned that relatives told them that the drought frequency is lower and that crops like corn grow taller and would offer higher yields than in Palu Valley. For migrants who worked as day labourers in regions of origin, the higher wages paid on the cocoa plantations were important factors for their migration decisions. Migrants stated that in regions of origin they got 10.000<sup>11</sup> IDR per day, but they could earn up to 20.000 IDR per day on the cocoa plantations in the Palolo-Valley.

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<sup>11</sup> Indonesian Rupiah (IDR), 1€ is equal to 14109,51 IDR (exchange rate from 02.10.2009, XE.com)

## **5.5 Household strategies of non-migrant households in the Lore-Lindu Region**

For better comprehension of migration causes it is reasonable to conduct research in regions of origin as well as in destination areas. A multi-local approach permits to compare migrant households and non-migrant households. The overall objective is to contrast different livelihood strategies in the face of environmental threats and to clarify why some households or household members choose to migrate whereas others successfully adapt in place.

In total four non-migrant farmers in Maranata and one migrant who left Maranata (to avoid iterating other migrants are only indicated in table 2, in general their statements are already described in section 5.2-5.3) were selected for this comparison (see table 2). In addition, two participatory rural appraisal sessions with local elites (non-migrants) were conducted in the village. The following lines emphasize those statements made from non-migrants about their livelihood strategies they used to cope with environmental change occurrences. The migrant was interviewed in Dongi-Dongi. All of the interviewed migrants stated that land scarcity and insufficient water supply were serious threats to achieve a sustainable household income or built an important barrier to establish an own household.

Migrant (5) mentioned that he lived just as 10 other family members in the household of his parents. His parents did have only 0.5 ha land to supply their household. He additionally proclaimed problems with Gumbasa irrigation system. To cope with the irregular water supply and frequent droughts, his household tried to adapt the agricultural production. In periods without irrigation, they tried to plant vegetables and peanuts in periods with irrigation, they tried to grow paddy. Because of the high precipitation variability, rain fed agriculture was highly insecure. Due to the inconstant household income, his parents could not buy additional land to provide their children with the possibility to establish an own household in Maranata. The income the migrant gained through day labour positions was also not sufficient to buy land in the village. Because of the easier access to land resources his parents recommended him to move to Dongi-Dongi. Hence, his migration can explained by a response to environmental forces (e.g. drought), to poverty (not enough financial resources to afford additional land), and to life cycle features (establish an own household).

**Table 2: Comparison migrants and non-migrants (based on information from the head of the households)**

Interview	Ethnic group	Education	Natural hazard	Household members	Acreage (ha)	Crops	Off-farm income
Non-Migr. 1	Kaili Da'a	SMA <sup>12</sup>	drought, disturbed irrigation due to landslides	7	3,5 (2,0 irrigable)	wet rice, cocoa, jarak <sup>13</sup> , teak	non
Non-Migr. 2	Kaili Da'a	SMA	drought, disturbed irrigation due to landslides	4	1,3 (irrigable)	wet rice, water melons, chili	day labourer in agricultural sector
Non-Migr. 3	Kaili Da'a	SMA	drought, disturbed irrigation due to landslides	5	0,25 (irrigable)	wet rice, corn, peanuts	rattan, kiosk, day labourer construction sector, temp. migration
Non-Migr. 4	Kaili Da'a	did not graduate	drought, landslides	5	0,5 (not irrigable)	corn, peanuts, cassava	kiosk
Migr. 1	Kaili Da'a	SMP <sup>14</sup>	drought	n. a.	leased	wet rice	carpenter, day labourer
Migr. 2	Bugi	did not graduate	drought	n. a.	1,0 (leased) (irrigable)	wet rice, tobacco, corn, tomatoes,	non
Migr. 3	Kaili Da'a	SD <sup>15</sup>	drought	5	2,0 (shared with other households)	wet rice, chili, corn	non
Migr. 4	Kaili Da'a	SD	drought	4	0,5 leased	wet rice	non
Migr. 5	Kali Da'a	SD	drought	10	0,5 (owned by his parents)	wet rice	non

<sup>12</sup> SMA: Sekolah menengah atas, similar to senior high school, from class 10-12.

<sup>13</sup> Jatropha curcas, a drought tolerant shrub which can be used for bio fuel production

<sup>14</sup> SMP: Sekolah menengah pertama, similar to junior high school, from class 7-9.

<sup>15</sup> SD: Sekolah dasar, similar to elementary school, from class 1-6

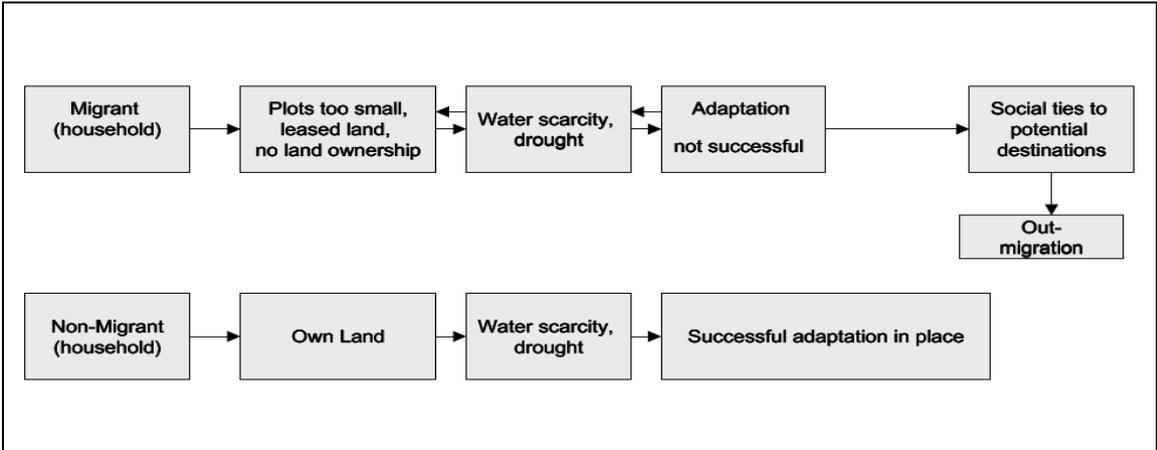
In contrast to the statements of migrant (5) and those described in chapter 5.3 and 5.4, the non-migrant households selected for this comparison have to cope with the same ecological threats and in some cases the same socioeconomic threats, but they employed other strategies instead of permanent out-migration (see figure 2). Non-migrant household (3) assured that their wet rice plot sized only 0.25 ha. If water supply is sufficient they try to grow wet rice, if not they struggle to plant peanuts and corn. To achieve additional income, the household runs a small kiosk. They sell several products for daily use and prepaid cards for mobile phones. In case of drought- induced income deficiencies, they gain income by working in the construction sector in the village or by temporary migration. Furthermore, they collect Rattan in the surrounding woodland to achieve supplementary income. On the question why they do not move to a less drought-prone and less populated area with more land resources, they responded that they could gain enough off-farm income in case of severe droughts because of their kiosk and their work in the construction sector.

The head of non-migrant household (2) mentioned that they use water pumps and wells to reduce their dependency on the Gumbasa irrigation system. Their water pumps cannot dig enough water for wet rice cultivation but they can compensate shortfalls and they stimulate the cultivation of vegetables, watermelons and peanuts. He stated that by using water pumps he can generate one wet rice harvest and, additionally, two vegetable harvests per year. Apart from the higher drought resistance of vegetables like chilli, they reach higher market prices and thus a higher income. Their strategies appear very successful. The interview partner stated that they achieve a higher household income during droughts because of the use of water pumps which maintains their production and which provides successful harvests in periods in which other farmers have to stop their production.

Despite governmental restriction, the non-migrant household (1) grows cocoa by using water from Gumbasa irrigation system. Cocoa is much more drought tolerant than wet rice and reaches higher market prices than paddy. In addition, they implement an initiative from the Indonesian forestry department to grow jarak and teak on fellow land in drought prone areas. Beyond, the household receives remittances which they invest in livestock (chicken, goats).

The fourth household selected for this comparison possesses 0.5ha of non-irrigable land. During rainy season they grow corn, during the dry season they plant peanuts. In addition, the household owns some tamarind trees which are very drought tolerant and which permits a small constant income. Supplementary income is achieved by running a small kiosk.

The results from the PRA-Sessions are confirming most of results from the household interviews. They show that the non-migrant households are also using those strategies already described in chapter 5.3. In particular, collecting forest products and taking only two meals instead of three a day, consuming cassava instead of rice, and temporary working-migration or working as a day labourer are popular strategies when facing a drought occurrence or a breakdown of the Gumbasa irrigation system in Maranata. Temporary migrants from Maranata are in general working in the construction or transport sector of Palu. Day labourers are also working at a laying battery inside the village to achieve additional income. Concerning the strategies used by the non-migrant households, the educational level needs to be highlighted. The household heads from the non-migrant households (1)-(3) do all hold a SMA (*sekolah menengah atas*) degree which is equivalent to a high school diploma or the German *Abitur*. Probably, the higher educational level resulted in more innovative agricultural techniques and permitted a better access to off-farm income sources.



**Figure 2: Migrant and Non-migrants in the face of environmental change**

The comparison shows again, that environmental change is affecting the livelihoods of households which left the village and as well those which do not move. For the migrants which left Maranata, environmental change is one among other factors influencing their migration decision (see figure 2). The chapter evidences that households are using different strategies to cope with declining water resources and frequent droughts. The comparison indicates that there is no direct relationship between environmental change and out-migration (Black 1998; Meze-Hausken 2000). Households that hold their own and sufficient land resources, develop successful adaptation strategies such as supplementary irrigation systems or reliance on off-farm income.

## 5.6 Comparison of livelihood strategies in regions of origin and destination villages

In regions of origin, most of the interviewed migrants did not have their own land or did not have enough land to supply the entire households. Those migrants which did not own land often relied on the land of their parents. In areas of destination, the migrants were very successful in allocating land resources. After migration, nearly all interviewed households hold more agricultural plots than before. In destination areas, they have access to land resources, which they regularly reached through kinship ties and often inside the Lore Lindu National park. In particular, the National park serves as a land reserve for landless migrants which cannot manage to buy land.

The migration of many households leads to land use changes. In some cases the migration was purposed to afford land use change. In regions of origin, the migrants grew food crops such as corn, peanuts, cassava, rice (*sawah* or *ladang*<sup>16</sup>). In the destination villages Bulili, Dongi-Dongi, and Rompo the interviewed migrant households cultivated almost all the cash crop cocoa and additionally some food crops, often those already planted in regions of origin. Cocoa cultivation, especially on recently cleared forest soils enables high returns and contributes to a significantly higher household income. The new wealth of a number of migrant households is visible through their stone houses and their satellite dishes. In regions of origin nearly all migrants had frame houses or timber barracks. Furthermore, according to an experiment recently conducted by Schwendenmann et al. (2008) in the framework of the collaborative research centre STORMA, cocoa is relatively resistant to ENSO-related droughts.

The third factor influencing the income of rural households is the availability of off-farm employment. The availability of off-farm income opportunities has to be regarded separately for each destination villages and for the different regions of origin. Migrants from the slopes of the Palu Valley mentioned that, beside the collection of forest products (cf. rattan), off-farm income opportunities were nearly non-existent. Additional off-farm income could be gained only through temporary migration to the provincial capital Palu. Migrants from Palu Valley stated that off-farm employment opportunities in the construction sector were hardly to obtain and only temporary. Employment opportunities in the agricultural sector, for example on the wet rice fields, were only seasonally available and highly dependent on the availability of irrigation water. Migrants living in Bulili and Dongi Dongi indicated that they do not have

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<sup>16</sup> Indonesian for field or plot used in the local language (Bahasa Kaili) for dry rice farming

any difficulties finding additional income sources either in agricultural sector or in the construction sector. The vast cocoa plantations, the wet rice fields next to Gumbasa River, and the dense settlements in the Palolo-Valley provide many off-farm income sources. Migrants living in Rompo mentioned difficulties in finding off-farm employment opportunities, due to the peripheral location of the village. Additionally in all three villages some of the migrant households are migrating frequently, though, temporarily to Palu or to other regions to gain additional income. Several interviewed households in the villages Bulili and Rompo are running small kiosks and gas stations to gain additional income. Those migrants running kiosks all stated that they did not run kiosks in regions of origin.

Due to a higher average precipitation rate, the respondents' destination areas are generally less exposed to environmental hazards such as droughts. Nevertheless the destination areas are as well exposed to ENSO related droughts and other environmental hazards such as floods or landslides. Migrants did not mention droughts affecting their household income at their actual place of residence. In regard to the improved socioeconomic conditions of the migrant households after their movement, it is very likely that they are less vulnerable to environmental change occurrences. However, deforestation and the expansion of agricultural plots are already affecting the environment of the survey villages. Changing rainfall patterns, higher temperatures, landslides and floods were reported. Up to now, the impacts on household income in the villages were not grave.

## **6. Discussion and Conclusion**

Following Lonergan (1998), Meze-Hausken (2000), and Wood (2001) migration was seen as one potential strategy in the face of environmental changes. The results presented in this paper showed no evidence for a direct relationship between environmental change and migration. However, environmental change due to deforestation is affecting the livelihoods of rural households in the research area. Furthermore more frequent ENSO events and climate change have increased the drought risk in the research area.

People complained about declining precipitation and declining water yields which are putting their agricultural income at risk. Frequently mentioned impacts of droughts are: crop failures, only one instead of two wet rice harvests, and less harvest due to withered plants. Moreover, respondents complained about declining soil fertility which led to increased production costs.

Recently, due to increased deforestation, environmental change is also affecting migrant destination areas.

Those migrants from Palu Valley particularly stated that environmental factors such as drought or water scarcity induced their migration decisions. Prior to migration those households which stated that environmental factors were provoking their movement used various strategies such as achieving additional income by working as agricultural day labourer, as day labourer in the construction sector, or they tried to adapt their agricultural production to cope with this environmental change impacts. The adaptation strategies mostly did not fail because of a declining natural resource base or environmental change impacts. They failed probably because of difficulties to find off-farm employment opportunities and because of the fact that most migrants had very small plots and not enough financial sources to invest in additional plots.

Moreover, the introduction of cocoa to the Lore Lindu Region is a key incentive for migratory movements in and to Central Sulawesi. Cocoa permits higher returns and lower production costs than wet rice or annual crops such as corn or peanuts. However, due to insufficient precipitation, bad soil quality and insufficient air humidity cocoa cultivation is not very profitable in the Palu Valley compared to the conditions in migrant destination areas. In particular, recently cleared forest soils are very attractive to former landless or small scale wet rice farmers because they increase the rents. A further consequence of the cocoa boom is high immigration from South Sulawesi, probably higher land prices and a rapidly increasing deforestation rate.

The factors provoking migration decisions in the Lore Lindu Region are quintessentially for rural migration in tropical developing countries. These factors clearly show that access to land resources has a significant role for migration decisions. Arable land is easily accessible at the forest frontier. In the case of the Lore Lindu Region the forest frontier has a more tempered and more humid climate than emigration areas, which are additional incentives for migratory movements to the forest margins. The results show that pull-factors provoking migration are very homogenous. Nearly all migrants referred to “classical” forest frontier factors such as land availability and soil fertility. The results confirm the special importance of social networks for rural migration as indicated by Brown et al. (1985). The interviewed frontier migrants stated that they had already kin- and friendship ties to their respective destination areas. Those contacts helped them to get access to agricultural plots and employment opportunities. The results presented in this paper show that theoretical approaches developed

for rural to urban migration such as the New Economic of Labour Migration (NELM) approach (Stark et al. 1985) can not completely illuminate intra-rural migration. Most of the permanent rural migrants do not move to search employment; rather they move to search land or better ecological conditions for agriculture. However temporary migration of household members in the Lore Lindu Region is often directed to the urban centres in order to seek employment positions to overcome income shortages. In the light of the NELM approach, these movements can be regarded as joint strategies from migrants and non-migrants to reduce income risks. As indicated by Stark et al. on labour migration in particular, the statements from migrant 5 in the section 5.5 show that “ *migration decisions[...] related to land issues [...]are often made jointly by the migrant and by some group of nonmigrants*“(1985: 174).

It is problematic in this way that environmental change in regions of origin which at least partly influenced migration decisions (in particular migration from Palu Valley was environmental induced) is recently affecting migrant destination areas. According to Faust et al. (2003: 23), population growth in the research area by 1% leads to an expansion of the agricultural area by 1%. Further immigration to the forest frontier, and the expansion of the agricultural area combined with unsustainable land-use practices, may intensify environmental change and natural hazards such as landslides and floods, which were already reported by respondents (see also Binternagel et al. 2010) and which may sharpen the impacts on household incomes in future.

The paper shows that environmental, economic, and development issues are influencing migration decisions, and are related to each other. A badly managed irrigation system is more vulnerable to declining water resources. The handing over of logging concessions and a high tolerance of governmental agencies to illegal logging and deforestation in watershed areas sharpens irrigation problems. Unsustainable land-use practices (e.g. too short swidden cycles due to an increased population density) has been leading to declining water yields, floods and landslides. Deforestation has been further increasing the drought risk. The promotion of very drought sensitive crops such as wet rice by governmental agencies has led to highly vulnerable household incomes – in the case of a prolonged drought or a breakdown of the irrigation scheme. The poorly managed resettlement projects conducted in the 1960s and 1970s which in some cases transferred, agricultural plots smaller than 0.5 ha, to the participating households contributes to the land scarcity mentioned by many migrants. Recently, the introduction of cocoa has further sharpened the land scarcity and due to bad

ecological conditions for cocoa cultivation in the Palu Valley and its slopes additionally has pushed migrants to the forest frontier.

Finally, the adaptation and innovation capacity of some small scale farmers needs to be highlighted. Despite of bad ecological conditions for permanent agricultural cultivation in the village of Maranata in the dry Palu Valley, a number of farmers developed successful strategies to achieve a stable household income. They established their own irrigation systems, instead of the centralized and undercharged public irrigation system, and they grow ecological more adapted plants such as peanuts and chilli. Others plant drought resistant tree crops such as teak and jarak or are using the water from the Gumbasa system in spite of restricting governmental regulations for cocoa cultivation. Furthermore, some households are running kiosks and are selling innovative products with a growing demand such as prepaid cards for mobile phones. For reducing the migration pressure on the forest frontier the promotion of more drought resistant crops instead of wet rice, the renovation of the Gumbasa irrigation system, and a more equal distribution of irrigation water and the promotion of decentralized irrigation systems as supplementary water sources are inevitable. However, a renovation of the Gumbasa system is only useful if deforestation in the watershed of the Gumbasa River and on the slopes of the Palu valley can be stopped.

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