Resilience in Climate Stressed Environment Through Water Grabbing

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Contents

Abstract

Climate change (CC) is currently considered as the most severe and devastating environmental catastrophe facing the globe. CC is the latest environmental driver of global environmental change causing rainfall shortage and water stress across the globe. This chapter reports a study carried out on water grabbing as solution for food production and water shortages in CC-stricken areas along the Pangani River Basin (PRB) in Tanzania. Results indicated that the mean yields before

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water grabbing were statistically ($P < 0.001$) higher than yields after water grabbing. Drivers for water grabbing include climate change and variability in some parts of the world, human population dynamics, change of consumption patterns, economic growth, and technological advancement. The effects of CC and water grabbing include loss of some aquatic flora and fauna, water use conflicts, and poor crop production. It is recommended that smallholder farmers have to adapt to drought-resistant crops and short-term seed varieties and carry out groundwater research and rainwater harvesting. More research should be carried out so as to know the link between CC and the decline of rainfall and water flow. Moreover, efforts should be made to conserve the Kilimanjaro Mountain to restore the vanishing ice cape.

Keywords
Ecosystem services · Land grabbing · Population growth · Climate change · Water

Introduction

Water resource depletion and rising demand on limited water supplies result in putting at risk ecosystem services (ES) thereby creating water use conflicts and significant deterioration of water and aquatic life (UNDP 2006; URT 2002). The problem is exacerbated by climate change (CC), climate variability, and competition for water uses, notably for large-scale agriculture. Commercial pressure on land and water and its consequence on small farmers are among the major issues being discussed at local, national, and international scale (Cotula et al. 2009, 2011; Hall 2011; Rulli et al. 2012; World Bank 2010). For instance, water has been the prime target of the continued pressures exerted by developed countries and international commercial firms in their acquisitions of land on the African continent (Cotula and Vermeulen 2009a, b; GRAIN 2008; White and Dasgupta 2010; Borras et al. 2012).

Throughout history, human development has depended on water and the potential of water availability as a productive resource (UNDP 2006). Water for life and livelihoods are two of the foundations for human development. Yet, in recent years (World Bank 2010), large section of local communities in the African continent has not benefitted significantly from water-related ES due to the way large-scale foreign firms are established and implemented. In different parts of Tanzania, for instance, water sources and their associated ES are deteriorating due to the establishment of large-scale plantations. The establishment of *Jatropha*, sugarcane, aloe vera, oil palm, *Croton megalocarpus*, and white sorghum (Sulle and Nelson 2009; Gordon-Maclean et al. 2008) has resulted in exclusive rights for land and water which led to what is popularly known as "water grabbing." Excessive water withdrawals and abstraction resulted in water stress and scarcity thereby affecting downstream smallholder irrigators (Lankford 2005a, b; Lankford and Mwaruvanda 2005; Sotthewes 2008; Franks et al. 2011). The situation has been accelerated with the impacts of CC and climate variability in some parts of Tanzania (Lalika et al. 2017; Lalika 2017).

Since mid-1990s, water grabbing has been the order of the day along the Pangani River Basin (PRB). The presence of the mushrooming foreign and private companies mainly dealing with flower irrigation is causing water stress and scarcity; hence water use conflicts along the PRB (Mbonile 2005; Mbonile 2001; Ngana et al. 2010; Lalika et al. 2011). This situation has been worsened by policy failures to enforce clauses and conditions stipulated in signed investment contracts (Sulle and Nelson 2009; Matondi 2010; Komakech and van der Zaag 2011). Despite the presence of well-developed institutional structures and policy frameworks on water, environment, and land management in the country including the National Water Policy (URT 2002), Land Policy (URT 1995), Land Act of 1999 (URT 1999a), Village Land Act of 1999 (URT 1999b), and Environmental Policy (URT 1997), smallholder farmers in the PRB are still affected by water stress and water shortages.

Policy failures to regulate allocation and enhance equitable water distribution have been exacerbated by the influx of human population along the PRB (Mbonile 1999a, b, 2001). The repercussions of population increase may reflect the now classical economic theory of population growth and resource scarcity of Malthus (1798). Malthus in his famous publication on population growth feared that the interaction between people and resources (water) would mean that the combined effects of population growth and increasing demand on a fixed water resource base would have consequences on water stress at an extraordinary scale. His views hold water in today's modern life and water scarcity situation along the PRB.

Water scarcity has been exaggerated by the current impact of CC change, and smallholder farmers have resorted to water grabbing as solution for irrigated agriculture. Nevertheless, there are little information on studies about the empirical evidence on the role of water grabbing as solution in climate stressed areas and water shortage problems along the PRB. The current chapter is an attempt to fill this existing information gap.

The objectives of this chapter were (i) to determine the effect of water grabbing on crop yield along PRB, (ii) to identify drivers for water grabbing in PRB, (iii) to analyze population dynamics in PRB, and (iv) to review and analyze land and water deals in Tanzania. Findings of this chapter and subsequent recommendation are useful to land use for policy makers for making decisions on different land uses and allocation. In addition, the policy recommendations of this chapter could be instrumental for other stakeholders aiming to achieve a more equal water distribution along the PRB.

Materials and Methods

Description of the Study Area

Location

The research for this chapter was conducted in four villages, namely, Patanumbe and Valesca villages in Meru District, Arusha Region; Mawala village in Hai District; and Ngasinyi villages in Moshi Rural District, Kilimanjaro Region along the PRB,

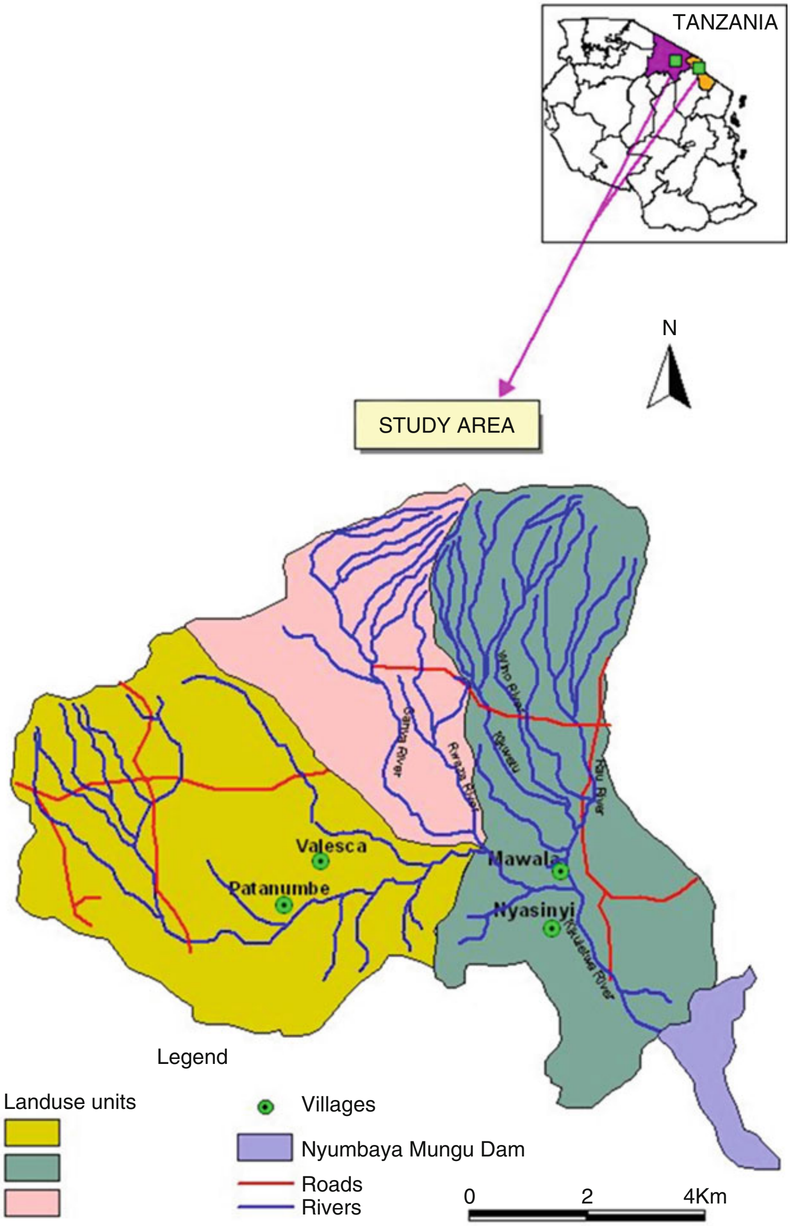

Fig. 1 Location of the study area along Pangani River Basin, Tanzania

Tanzania (Fig. 1). The PRB extends from the northern highlands to the northeastern coast of Tanzania. It lies between latitude 03° 05′ 00″ and 06° 06′ 00″ south and longitude 36° 45′ 36″ and 39° 36′ 00″ east.

Hydrology and Drainage Pattern

The hydrology and drainage pattern in the PRB catchment vary considerably. The PRB comprises of several sub-catchments of widely different characteristics. The Pangani River (PR), which is also referred to (in other publications) as the Pangani Mainstem, rises as a series of several small streams and springs on the southern sides of the Africa's highest peak, Mt. Kilimanjaro, and on Mt. Meru (IUCN and PBWO 2008; IUCN 2007). These streams (Nduruma, Tengeru, Sanya, Malala, etc.) create the Kikuletwa and Ruvu Rivers (Himo, Muraini, etc.) which drain further downstream into the Nyumba ya Mungu (NyM) dam (IUCN and PBWO 2008, 2011; IUCN 2007). The NyM dam has created a man-made water reservoir of ecological and economic importance along PRB. The overflow of the dam (outlet) is known as the Pangani River Mainstem and flows for 432 km before emptying into the Indian Ocean at the Pangani estuary.

The NyM reservoir is the largest water body in the PRB and was constructed in 1965 to enhance river flows for hydropower generation. It was later incorporated into irrigation plans (Mulungu 1997; Ndomba et al. 2008). Besides the power station at the outlet of this dam, other hydropower plants in the PRB are located near Hale and New Pangani Falls. Water released from the NyM dam is essential for supporting ecosystem services downstream. These include nutrient cycling at Kirua Swamp and sedimentation and support of enhancement of ecological processes (e.g., hindering salt water intrusion and coastal erosion) at the estuary mouth in Pangani Town (Ndomba et al. 2008; Shaghude 2006; Sotthewes 2008; Valimba 2005, 2007). Other river tributaries draining in the PRB are Mkomazi and Luengera from the Pare and Usambara Mountain ranges, respectively.

Forest and Vegetation Types

Forest and vegetation in PRB range from forests on mountain slopes to semiarid grasslands (IUCN 2003). The main vegetation types include forests, woodlands, and bushland, along with grassland thicket and plantation forest (Turpie et al. 2005). Plantation forests have replaced natural forests in the highlands, and the larger part of the lowlands is composed of woodland, bushland, grassland, and thicket. Forests perform vital hydrological functions in the PRB including the regulation of runoff, prevention of soil erosion, water storage, and improvement of water quality (IUCN 2003; Msuya 2010). According to IUCN (2003), dominant forest types in PRB include *mangrove forests* (located at the confluence of the Pangani River and the Indian Ocean and protecting the coastlines and soft sediment shorelines from erosion, trapping sediments, and recycling nutrients), *East African coastal forests* (containing remarkable levels of biodiversity and endemism), *Afromontane forests* (playing a key part in hydrological functions), and *riverine forests* (controlling erosion along the river banks). Research and previous studies on forest health conducted in the PRB show that between 1952 and 1982, catchment forests in the PRB declined at a fairly high rate of 3.8% of forest cover per year, while farmlands and settlements increased dramatically by 83% of forest cover per year (Kaoneka 1993; Lambrechts et al. 2002; Newmark 1998).

Climate

Variations in the local climate in the PRB are mostly related to topography. The flatter, lower-lying southwestern half of the basin is arid and hot, while the mountain ranges along the northern and southeastern catchment boundaries have cooler, wetter conditions. The high altitude slopes above the forest line on Mt. Meru and Mt. Kilimanjaro have an afro-alpine climate and receive more than 2500 mm of rainfall per year. Mean annual rainfall increases in a southerly direction along the mountain ranges and varies from about 650 mm per year in the north and south Pare Mountains to 800 mm per year in the western Usambara Mountains and 2000 mm per year in the eastern Usambara Mountains.

Population and Economic Activities

The PRB has an estimated 4.5 million people (data from 2007), and population densities vary between highlands and lowlands. About 90% of the basin's population resides in the highlands with some 900 people per km^2, while lowland densities were around 65 people per km^2 (IUCN 2003). The main causes of forest degradation and deforestation include encroachment for settlement and agriculture as well as increasing demand of forest products (mainly timber and fuel wood) (IUCN 2003). In terms of human population, PRB is a densely populated area in Tanzania, posing serious challenges to sustainable watershed management (Msuya 2010).

Data Collection

Sampling Procedure

A purposive sampling procedure was used where four villages were earmarked for the questionnaire survey (two in Arusha and Kilimanjaro regions, respectively). The decision on the location of the villages was based on their proximity to rivers and the reliance of the local communities on water for irrigation. Based on these two criteria, the main target for this survey was smallholder irrigators. Within each village, respondents were selected using a table of random numbers that corresponded to the household numbers in the village register. Household heads were the target for interviews; however, wherever the head of the household was not around, any household member within that particular household who of 18 years or above was picked for interviews. According to Tanzania regulations and laws, any one at 18 years or above is regarded as mature person. I adapted the 10% sampling intensity giving a total of 170 respondents were interviewed (Table 1).

Data Collection Methods

Quantitative and Qualitative Data

During data collection, both quantitative and qualitative research approaches were used to collect primary and secondary data. Structured questionnaires were used as the main tools to collect primary (quantitative) data. Questionnaire items comprised of questions mainly on drivers/factors of water grabbing, socioeconomic activities, types of water investors/grabbers, types of watershed services affected by water grabbing, crop yield before and

Table 1 Sampled and interviewed respondents

Region	Village	Total households	Sample size
Kilimanjaro	Mawala	330	33
	Ngasinyi	440	44
Arusha	Valesca	500	50
	Patanumbe	430	43
	Total	**1700**	**170**

after the coming of investors, and environmental and socioeconomic effects of water grabbing, to name just a few. Also, different methods for collecting qualitative data were used. Among others, these methods include group focus discussions, face-to-face interviews, and informal and formal interviews. Secondary data were searched and reviewed relevant literatures on irrigated agriculture and water use conflicts in the study area.

Data on Population Census

Data on population dynamics and increase in PRB were collected from the national library for Tanzania Bureau of Statistics in Dar es Salaam. These data were from the National Population Census which is normally conducted after every 10 years. Therefore, I collated population census reports for 6 years, i.e., 1957, 1967, 1978, 1988, 2002, and 2012. Thereafter, relevant information on PRB were extracted and later converted from analogue to digital format (Table 2).

Data on Water and Land Deals

Secondary data on land and water policy issues were reviewed from relevant document on land and water grabbing literatures. For policy issues, documents such as National Water Policy (URT 2002), Land Policy (URT 1995), Land Act of 1999 (URT 1999a), Village Land Act of 1999 (URT 1999b), and Environmental Policy (URT 1997) were reviewed. On land and water grabbing, reviewed document includes Biofuels in Tanzania: Status, Opportunities and Challenges (Mshandete 2011); *Biofuels, Land Access and Rural Livelihoods in Tanzania* (Sulle and Nelson 2009); Foreign land acquisitions in Tanzania: Global ideology and local perspectives (Larsen 2002); Biofuel Industry Study in Tanzania (Gordon-Maclean et al. 2008); and Accumulation by land dispossession and labour devaluation in Tanzania (HakiArdhi 2010).

Data Analysis

Quantitative and Qualitative Data

The 170 structured questionnaires were coded, entered, and cleaned for final analyses. The Statistical Package for Social Sciences (SPSS) version 20.0 was used to analyze quantitative data collected through the structured questionnaires. Later on, multiple response analysis was carried out to obtain frequency and percentages of responses from smallholder farmers. On the other hand, qualitative data were analyzed with the help of participants during group focus discussions through dialogue and intensive debates.

Table 2 Population dynamics in Pangani River Basin, Tanzania

	Years and population					
Region	1957	1967	1978	1988	2002	2012
Kilimanjaro	476,530	650,533	902,437	1,108,699	1,376,700	1,640,090
Tanga	375,923	769,504	1,037,767	1,283,636	1,636,280	2,045,210
Arusha	399,866	601,515	926,223	1,351,675	1,288,090	1,694,310

Population Census Data

Data on population census for five window periods, i.e., 1957–1967, 1968–1978, 1978–1988, 1988–1998, and 2002–2012, were scrutinized, rearranged, and grouped in a single table (Table 10).

With regard to statistical tests of crop yield before and after water grabbing, a two-tailed t-test was used.

Null hypothesis: There is no significant difference in yield before and after water grabbing.

$$Ho : \mu_1 = \mu_{2,}(\text{i.e.}, \mu_1 - \mu_2 = 0)$$

Alternative hypothesis: There is significant different in yield before and after water grabbing.

$$H_1 : \mu_1 \neq \mu_{2,}(\text{i.e.}, \mu_1 - \mu_2 \neq 0)$$

To test and compare the means for the net loss in yield before and after water grabbing between villages and within villages, the following hypothesis was used:

> "There is no significant difference in net loss in yield before and after water grabbing."

One-way analysis of variance (ANOVA) was applied to test this hypothesis. Thereafter, the Duncan multiple range test was applied to separate the means.

Results

Effect of Water Grabbing on Crop Yield Along PRB

The results in Table 3 indicate that mean yields and their respective standard deviations (std) before water grabbing were higher than yields after water grabbing in all villages. This implies water loss due to water grabbing had negative effects on crop yield. Similarly, findings in Table 3 indicated that standard deviations for yield before water grabbing were higher than their means only in two villages (i.e., Mawala and Patanumbe).

Furthermore, a two-tailed statistical test was applied to test the significance of the crop yield before and after water grabbing. The two-tailed t-test was preferred

Table 3 Maize means yield before and after water grabbing (kg/ha/season) in PRB, Tanzania

Village	Maize Yield (kg/ha/season)	Mean ± Std	Std error mean
Mawala	Before water grabbing	1479.89 ± 2931.02	544.28
	After water grabbing	355.17 ± 214.88	39.90
Patanumbe	Before water grabbing	846.30 ± 1097.75	167.41
	After water grabbing	252.36 ± 150.66	22.98
Valesca	Before water grabbing	1255.31 ± 663.56	95.78
	After water grabbing	462.76 ± 271.68	39.21
Ngasinyi	Before water grabbing	1067.54 ± 503.82	77.74
	After water grabbing	480.00 ± 237.95	36.72

Table 4 Statistical test for crop yield before and after water grabbing (kg/ha) in PRB, Tanzania

Village	Mean ± Std	Std error mean	t-value	Sig (two tailed)
Mawala	746.14 ± 1374.82	108.02	6.91	0.000***
Patanumbe	593.93 ± 1060.42	161.71	3.67	0.001***
Valesca	792.54 ± 527.69	76.17	10.41	0.000***
Ngasinyi	587.54 ± 375.96	58.01	10.13	0.000***

***Significance at $P < 0.001$

Table 5 Net loss in crop yield in PRB, Tanzania

				95% Confidence interval for mean	
Village	N	Mean ± Std	Std error	Lower bound	Upper bound
Mawala	29	485.06 ± 704.22	130.77	217.19	752.93
Patanumbe	43	562.54 ± 1044.38	159.27	241.13	883.95
Valesca	48	795.52 ± 528.13	76.23	642.17	948.87
Ngasinyi	42	587.54 ± 375.96	58.01	470.38	704.70
Total	162	624.18 ± 708.38	55.66	514.27	734.09

because the assessment was from the same respondents for the two scenarios (i.e., yields before and after water grabbing). Results are summarized in Table 4 below.

As denoted in Table 4, the mean yield before and after water grabbing was statistically significant ($P < 0.001$). Thus, the null hypothesis that "there was no significant difference in mean yield before and after water grabbing" was rejected.

Results from one-way ANOVA on the net loss in crop yield are displayed in Table 5. While the standard deviation for the net loss in Mawala and Patanumbe villages was greater than their respective means, the situation was opposite in Valesca, and Ngasinyi villages means were greater than their respective standard deviations.

Results on statistical test about the net loss between and within villages before and after water grabbing are displayed in Table 6.

It was revealed that $p = 0.225$. Therefore, $p > 0.05$ implying that there was no significant difference in yield net loss between villages and within villages. Based on these findings, the null hypothesis is hereby accepted.

Table 6 One-way ANOVA statistical test for net loss between and within villages in PRB, Tanzania

Villages	Sum of squares	df	Mean square	F	Sig.
Between villages	2190236.13	3	730078.71	1.47	0.225**NS**
Within villages	78600914.59	158	497474.14		
Total	80791150.71	161			

NS Non statistical significance ($P > 0.05$)

Table 7 Responses on local drivers for water grabbing in the PRB, Tanzania

Driver	Frequency	Percentage
Poor water governance	160	29.6
Corruption	150	27.7
Lack of transparencies in contracts/agreements	107	19.8
Inadequate environmental impact assessments	64	11.8
Lack of integrated planning	57	10.5
Top-down management approaches	3	0.6

Drivers for Water Grabbing

Drivers at (in PRB) Local Scale

Land and water grabbing are currently seen as the major problem to many poor families who rely solely on smallholder agriculture. In the PRB, we identified a number of local drivers for water grabbing (Table 7). According to perceptions from smallholder irrigators, they include poor water governance (29.6%), corruption (27.7%), lack of transparency (19.8%), inadequate environmental impact assessment (11.8), lack of integrated planning (10.5), and top-down management approaches (0.3%).

It was found that poor water governance in the PRB is related to inadequate administration in water conservation authorities, insufficient approaches in information delivery, policy isolation in conservation issues, and funding constraints (Charbit 2011), to name just a few.

As indicted in Table 7, corruption (27.7%) was identified as one of the drivers for water grabbing in the study villages. It was reported that some of unfaithful government leaders at national and local levels conspired with investors over investment contracts at the detrimental of smallholder farmers. Consequently, the situation led to water use conflicts and unnecessary loss of human properties and chaos. Furthermore, lack of transparency (19.8%) was identified as one of the drivers for water grabbing along the PRB. It was reported that lack of transparent and democratic decision process accounted a lot for the loss of land with ample water to investors. The absence of negotiation with the local communities contributes a lot to resource use conflicts (Mbonile 2005), and this was evident in this study along the PRB. Findings by the World Bank (2010), Cotula et al. (2009), and Rulli et al. (2013)

Table 8 Responses on global drivers for water grabbing

Driver	Frequency	Percentage
Climate change and variability	153	28.5
Global and local population growth	136	25.4
Shifting consumption patterns	134	25.0
Economic growth	113	21.1

reported similar sentiments that many land deals were done with inadequate local population involvement, inadequate compensation, and without clear plans for new jobs and ecological integrity. Other contributing drivers identified in the study villages include inadequate environmental impact assessments (11.8%), lack of integrated planning (10.5%), and top-down management approaches.

Drivers at Global Scale

Table 8 reveals drivers for water grabbing at international scale. Local communities' perceptions are that commercial firms that involve in water grabbing are new forms of neocolonialism.

Findings in Table 8 show that climate change (28.5%) plays a key role in global water grabbing. Climate change and persistent climate variability influence water (Boko et al. 2007) in some areas thus forcing multinational companies to shift their investments abroad.

Consequently, these investments affect water availability, accessibility, normal water circle, and daily economic activities of local communities in the area of destination.

It was also found that an increase of global and local human population (25.4%) is to blame for the current water grabbing in the PRB. During field excursion, it was found that different economic undertakings range from irrigation and ranching to mining. Some of these socioeconomic activities were carried out by either foreign investors or Tanzanians but from different areas of the country. Furthermore, it was revealed that population increase in PRB was either natural (i.e., natural birth) or artificial increase (through population immigration). Therefore, the number of human population outpaced the land's carrying capacity, thereby, resulting into completion for land and water resources. Confiscation of water resources and water withdrawals along the PRB is mainly for irrigated agriculture. The situation results in irrigation water scarcity to the downstream smallholder irrigators, social unrest, and resource use conflicts (Mbonile 2005; The Oakland Institute 2011).

The results of shifting consumer patterns (25%) are presented in Table 8. The combination of drivers such as climate change, economic growth, and global and local population growth has contributed to the shift of consumer preferences and change in production systems. These attributes when combined with the declining natural resource base result in poverty thereby exposing the rural poor in vulnerable situation. The situation is also evident in the PRB where change in consumer preference across the globe has driven some foreign firms to invest abroad. Changes in consumer behavior necessitate a deliberate transformation in the approach to

Table 9 Responses on ecosystem services affected by water grabbing in the PRB, Tanzania

Ecosystem service	Frequency	Percentage
Disappearance of fish species	104	29.3
Water for HEP production	63	17.7
Water for livestock uses	62	17.5
Disappearance of birds	55	15.5
Water for domestic use	37	10.4
Disappearance of aquatic plants/trees	17	4.8
Reduced food crop harvest	9	2.5

development and a significant increase of investment in agriculture in the developing world. For quite some time, foreign firms along the PRB are dealing with the production of sugarcane, *Jatropha*, flowers, vegetables, and horticultural crops instead of cereals (e.g., wheat and rice) and coffee that used to be grown in the previous years.

Results of economic growth (21.1%) as one of the global drivers for water grabbing are presented in Table 8. It is believed that once the economy flourish with super profit, it needs to be reinvested to generate more profit. The ideal area for this reinvestment is in developing countries (the African continent) where there is ample fertile and virgin land.

Other Ecosystem Services Affected by Water Grabbing

Table 9 presents findings of other ecosystem services that are affected by the appropriation (water grabbing) of water resources in the PRB.

Excessive water (abstraction) grabbing (29.3%) causes water fluctuation, change of river flow regime, and affects the river health. Water decrease affects fish breeding and supplies of tilapia species. In recent years, fishing activities have become seasonal due to water fluctuation accompanied by fish disappearance. Some parts of the river were no longer perennial; some had fast-flowing water, shallow areas, and deeper runs with fish species adapted to living in fast-flowing streams (e.g., *Garra dembeensis*) (PBWO and IUCN 2008). Some of fish species endemic to the PRB include the *Oreochromis pangani*. Mwamila et al. (2008) found that the reduction in water flow affected negatively fish productivity, whereas higher flows result into swamp and floodplain formation. Normally, flooding conditions are necessary for fish spawning, feeding, and growth of young fish species.

Table 9 reveals that hydroelectric power production (17.7%) is another crucial ES along the PRB which is affected by water grabbing. The NyM dam is the largest water body potential for hydropower production. Other hydropower plants affected by water grabbing along the PRB include Hale and Pangani. Other ES along the PRB includes water for livestock uses (17.5%), disappearance of water birds (15.5%), water for domestic use (10.4%), and disappearance of aquatic plants/trees (4.8%). Aquatic tree affected by reduction of water flow includes the fig trees (*Ficus* ssp.) which are adapted to surviving in dry areas due to their ability to reserve/store water and mangrove tree species. Other ES that is affected by shortage of water flow is

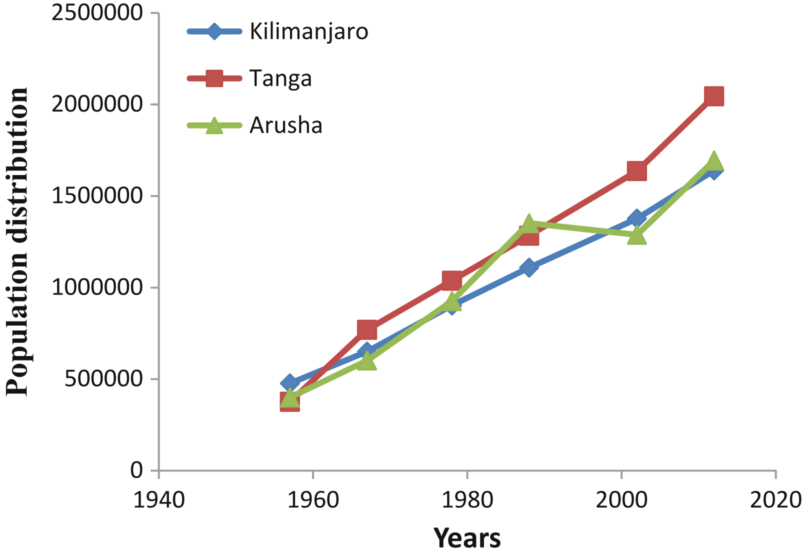

Fig. 2 Population dynamics for 1957–2012 along Pangani River Basin, Tanzania

food crop harvest (2.5%) as elaborated in section "Effect of Water Grabbing on Crop Yield Along PRB" in Tables 3, 4, and 5.

Population Dynamics in PRB

Figure 2 shows the trend of population increase along PRB. Overall, Tanga Region had many people than Arusha and Kilimanjaro (Table 2). This is also testified by the alignment of the trend lines in Fig. 2.

According to Fig. 2, population census 1957–2012 population increase was consistent in Tanga and Kilimanjaro regions. The dramatic fall of population trend in Arusha Region in 2000 is due to the split of administrative units where Manya Region was chopped out from Arusha Region. The increase of population trend is also reflected in Table 10 where population has increased over time.

Land and Water Deals in Tanzania

Table 11 summarizes examples of land acquired by foreign firms for biofuel plantations in Tanzania by the end of 2010. During literature review, it was realized that majority of investments were geared toward biofuel production for filling the void of energy demand. During the documentary review, it was found that majority of foreign firms engaged on large-scale plantations of *Jatropha*, sugarcane, aloe vera, oil palm, flowers, white sorghum, and *Croton megalocarpus*.

Table 10 Population changes along the Pangani River Basin, Tanzania, between 1952 and 2012

	Population per region		
Years	Kilimanjaro	Tanga	Arusha
1957	476,530	375,923	399,866
1967	650,533	769,504	601,515
1978	902,437	1,037,767	926,223
1988	1,108,699	1,283,636	1,351,675
2002	1,376,700	1,636,280	1,288,090
2012	1,640,090	2,045,210	1,694,310

Believers of the foreign investments assert that these investments would have positive outcomes to agricultural production, add value to local products and markets, and improve social services such as road infrastructure, health facilities, clean water supply, and education (HakiArdhi 2010). Experience, nevertheless, indicates that problems tied with foreign investments outweigh the perceived benefits.

Discussion

Effect of Water Grabbing on Crop Yield Along

Investment in irrigated agriculture is one of the main means of achieving sustained crop yield. It is through sustained crop yield where food security and community welfare can be ensured at household level. On the contrary, irrigated agriculture is faced with water grabbing by foreign investments (Table 3) something which leads to loss of crop yield. Sustainable agriculture and crop yield in the study villages are curtailed by foreign companies (located upstream) who abstract water for flower irrigation. Policy failures to enforce signed agreements (e.g., use of groundwater) are a testimony on how the policy framework hasn't answered problems of water shortages faced by smallholder irrigators.

The influence of water grabbing on crop yield indicated in Table 4 is another indicator of the plight of water grabbing to irrigated agriculture. Results of statistical significance on mean yield before water grabbing ($P < 0.001$) confirm how bad water grabbing is. Given the current situation of the failure of rainfed agriculture due to climate change and climate variability in PRB, irrigated agriculture would have been the solution for boosting crop yield and community livelihoods through increased income and provision of ES (i.e., food). Similar observation is echoed by FAO (2002) that increased crop yield has extra benefits than just income increase. Sustainable irrigation creates on-farm employment, ensures food security, and lowers food prices. Irrigated agriculture reduces poverty as well, because the poor normally spend 60–70% of their income on food (FAO 2002).

Table 11 Land grabbing status in Tanzania by 2010

S/N	Investor	Crop	Location	Land requested (hectares)	Land acquired (hectares)	Project status
1	FELISA	Oil palm	Kigoma	5000	4258	Land dispute in court for extra 350 ha obtained from 2 villages. No EIA done
2	BioShape	*Jatropha*	Kilwa, Lindi	82,000	34,000	400 ha pilot farm planted. Integrity of EIA questioned
3	Sun biofuel	*Jatropha*	Kisarawe, coast	50,000	8211	8211 ha of land formerly belonging to 12 villages transferred to general land; derivative title being finalized
4	SEKAB BT	Sugarcane	Bagamoyo, coast	24,500	22,500	Seed cane planted, and irrigation reservoir constructed
5	SEKAB BT	Sugarcane	Rufiji, coast	400,000	0	In land acquisition process
6	Diligent Tanzania ltd.	*Jatropha*	Arusha; Babati, Manyara; Handeni, Tanga; Singida; Monduli, Arusha	n/a	n/a	Contracted over 4000 farmers
		Croton megalocarpus		n/a	n/a	Collecting seeds from natural and planted forests
7	Donesta ltd. & Savannah biofuels ltd.	*Jatropha*	Dodoma	n/a	2000	200 ha planted
8	Trinity consultants/ bioenergy TZ ltd.	*Jatropha*	Bagamoyo, coast	30,000	16,000	Surveying land to be granted

(*continued*)

Table 11 (continued)

S/N	Investor	Crop	Location	Land requested (hectares)	Land acquired (hectares)	Project status
9	Shanta Estates ltd.	*Jatropha*	Bagamoyo, coast	n/a	14,500	Agreement with villagers signed
10	Tanzania biodiesel plant ltd.	Oil palm	Bagamoyo, coast	25,000	16,000	Land not surveyed; land granted by district but not by TIC
11	Clean power TZ ltd.	Oil palm	Bagamoyo, coast	n/a	3500	Project abandoned after realized high cost of doing land use plans
12	Agriculture bio-energy Tanzania	White sorghum	Bagamoyo, coast	n/a	25,000	Land request approved but asked to do land use plans
13	ZAGA	*Jatropha*	Kisarawe, coast	n/a	n/a	Applied for land
14	African green oils	Oil palm	Rufiji, coast	n/a	860	Planted 360 ha and financing land use plans in 7 villages
15	InfEnergy co. ltd.	Oil palm	Kilombero	n/a	5818	Land lease pending. Cultivating rice while growing oil palm
16	Massive	*Jatropha* and Pangamia	Lindi	n/a	50,000	
17	JCJ co. ltd.	*Jatropha*	Mwanza Mara Shinyanga Tabora	n/a	n/a	Aimed to sensitize local communities, but project abandoned due to alleged lack of government support
18	ABERC	*Croton megalocarpus*	Biharamulo, Kagera	n/a	20,000	No operational progress due to lack of funds
19	Prokon BV	*Jatropha*	Mpanda, Rukwa	n/a	10,000	Contract farming with 2000 smallholders; does not own

(*continued*)

Table 11 (continued)

S/N	Investor	Crop	Location	Land requested (hectares)	Land acquired (hectares)	Project status
						any plantation land
20	Mitsubishi corporation	*Jatropha*	Arusha Dar es Salaam coast	n/a	n/a	Looking for land in these regions
21	Kapunga Rice project	*Jatropha*	Mbarali, Mbeya	n/a	50,000	Planned to replant rice with *Jatropha*; president recently ordered that rice cultivation patterns not be changed
22	DI oils Tanzania ltd.	*Jatropha*			n/a	Abandoned plans for Tanzania
23	Kikuletwa farm	*Jatropha* and Aloe vera	Kilimanjaro	n/a	400	Growing *Jatropha*

Source: Adapted from HakiArdhi (2010), Gordon-Maclean et al. (2008) and Sulle and Nelson (2009)

Local and Global Drivers for Water Grabbing in PRB

Local in PRB

Water grabbing exists in PRB because local communities (majority of whom are small scale irrigators) have lost access to fertile land and ample water they used previously to support their living. Opinions from respondents suggest that poor water governance (Table 7) is the main driver for water grabbing in the study villages. Village and irrigation officers do not enforce the political, social, economic, and administrative procedure articulated in the bylaws guiding water use and distribution. Majority of villagers don't participate fully during contract negotiations and decision making. Lack of full local community's involvement leads to poor and unfair decisions at the detrimental of local communities. In the study villages, for instance, smallholder irrigators have no access to fertile land and water that they previously used to have the right to. In Arusha, large tracts of land are appropriated by foreign investors after signing with the government leaders. Local communities were poorly informed of the actual benefits and consequences of these land deals. As things stand, they have little rights to stop the land acquisition and claim the land back (Sulle and Nelson 2009). Furthermore, foreign companies located upstream divert large quantities of water (than the amount portrayed in the signed contracts) at the expense of downstream smallholder irrigators. This affects irrigation activities, provision of other ES (e.g., production of hydropower electricity), and the enhancement of ecological integrity along the river basin.

Corrupt leaders and lack of transparency are also key factors for water grabbing in the study villages. Responses from local smallholder irrigators revealed in Table 7 testify this existence. Decisions on who should be given a fertile land (and water) are corrupt oriented and are with low transparency and accountability. Findings from informal discussion with smallholder irrigators indicated that rampant corruption and absence of open village meetings are key to water grabbing in PRB. Consequently, once investment contracts are signed, environmental issues are not given special priority thus affecting the sustainable provision of ES and conservation of aquatic diversity within the river basins.

Inadequate environmental impact assessment, lack of integrated planning, and top-down management approaches are associated with the current level of water grabbing and water use conflict in the study villages. Large-scale investments on agriculture require a careful assessment of its environmental consequences before its initiation. FDIs of *Jatropha*, sugarcane, and flower plantations in Kilimanjaro and Arusha regions do not adhere to the recommendation from scientists about adverse environmental impacts. In turn, there have been cases of water pollution caused by agrochemicals and pesticides (Hellar and Kishimba 2005; Hellar-Kihampa 2011; 2013) thereby affecting aquatic species, ES, and human health. Sometimes, majority of these kind of investments are often negotiated at the highest level (e.g., national or regional level) neglecting the views of local leaders (at village levels) where investment are to take place. Moreover, important decisions on agricultural investment plans (poor planning) or integrated water resource management (IWRM) are always decided at ministerial level thereby leading to chaos and conflicts during implementation process. For example, uprooting natural forest in favor of large-scale plantation (e.g., sugarcane and *Jatropha*) affects biodiversity, water flow, river regime, nutrient cycling, and the other ES necessary for human well-being.

Global Drivers

Climate change and climate variability have already caused effects on production of food at global scale especially in developing countries. These negative effects are felt more on provisioning ES where significant reduction of maize, wheat, and rice yield has been reported (Howden and O'Leary 1997; Hoogenboom 2000; Gbetibouo and Hassan 2005; Challinor and Wheeler 2008). To feed the growing population in the areas hit by climate change and climate variability and also fill the gap of global food shortages and demands, investments are carried out in developing countries (including in the PRB Tanzania). However, the way these investments are carried out (i.e., excessive water abstraction) seems to have detrimental effects to the majority of native population and provision of ES. Water grabbing is depriving smallholder farmers of irrigation water thereby affecting the local economy.

Climate variability has accelerated the droughts, compromised rainfed agriculture and hence food shortages thereby necessitating irrigated agriculture. Land grabbing in the PRB is not just rush for fertile soil, rather it aims at fertile soil with ample water for irrigated agriculture. Thus the motive behind land appropriation is to carry out water irrigation because rainfall is not reliable for rainfed agriculture. These views concur with the argument by Rulli et al. (2012) who asserted that irrigated agriculture will remain the largest user of water where it accounts for more than 80% of use in developing countries.

Population increase has an implication on the future of natural resources, utilization, and conservation (Rulli et al. 2012). This is also revealed by the responses on Table 8 where respondents in PRB indicated that the global and local population growth enhance water and land grabbing. According to Mbonile (2005), global and local population growth result in increased food demands and changes in food preferences thereby exerting pressure on the global land and water resources to satisfy those growing human needs. The global land and water resources are, therefore, under severe demands to satisfy the needs of growing human population (Gleick 2000; HakiArdhi 2010; Molden and de Fraiture 2010; Rulli et al. 2012). In recent years, population increase has been accompanied with consumer preference on certain food types. Unfortunately, some of the preferred food types are not locally grown in European countries and in the USA, thus necessitating overseas plunder through water and land grabbing (World Bank 2010; White and Dasgupta 2010; Borras et al. 2012). The change of food preferences is sometimes induced by health reasons (high blood pressure and diabetes), lifestyle, indicator of income increase, or just effects of globalization. These changes influence types of manufacturing and processing industries, energy required, and raw materials as well. Thus, crossing the boundaries for water and land grabbing is a strategy to fulfill the consumers' requirements (Rulli et al. 2012) at the expense of ES at the area of destination.

As the economies tend to flourish, the need for reinvestments arises for capital accumulation (Harvey 2003). This in turn necessitates the exportation of surplus value (financial) for investment abroad. Therefore, economic growth (Table 8) is also a driver believed to have fueled water and land grabbing globally in the PRB. Developed countries like the Gulf States, China, the Netherlands, the USA, India, and South Korea are at the forefront of new investments in farmland abroad either for food or biofuel (von Braun and Meinzen-Dick 2009). In economic terms, financial capital is reinvested where production costs are much lower and where land and water are more abundant. Unfortunately, these foreign-funded biofuel and food plantations in PRB are causing environmental and socioeconomic disaster through watershed degradation, forest and biodiversity abuse, water use conflicts and ecological, significant reduction of ES (water), and sustainability uncertainty along the PRB.

Other Ecosystem Services Affected by Water Grabbing

Rivers require a certain quantity of water and quality of riparian vegetation for ecological integrity and to support aquatic life (Baker et al. 2006; Kediziora 2010; Randhir and Ekness 2013) including fish species. The current water abstraction in the PRB affects availability of ES, and low water flow is a problem to aquatic plants and ecological integrity. As indicated in Table 9, opinions from respondents show that low water flow affects existence of some fish species and aquatic plants. Low water level affects also hydroelectric power production at NyM dam, Hale, and New Pangani falls power plants. Increase of FDIs upstream consumes a lot of water intended for downstream smallholder irrigators and for electricity generation. Low contribution of these three electricity plants to the national electricity network affects the country's economy. Furthermore, reduced water flow and water level affects water bird breeding grounds, the bird watching sub-economy, and the tourist industry as well. Therefore, excessive water diversions (by investors) affect the bird watching tourism along PRB due to low water in the breeding grounds. Thus, efforts need to be done in order to improve water availability for domestic uses and restore aquatic plants and water tree species and water availability for crop-irrigated agriculture. Sustainability of these ES will ensure the welfare of communities residing along PRB.

Population Dynamics in the PRB

The population dynamics in the PRB (Table 10) according to population census between 1957 and 2012 is relatively in increasing trends. The increase has a clear implication to the supply of ES especially water for domestic and irrigated agriculture and more land for agriculture and settlement. But the timing of this increase is coinciding with influx of foreign investments looking for fertile land and ample water for investments. Substantial amount of water is abstracted by foreign companies (large-scale flower irrigators) that located upstream at the detrimental of smallholder farmers located far downstream.

Population growth along the PRB has resulted in increased number of irrigation farms, irrigation canals, and other human activities that rely on water use. As a result, water is not enough to satisfy human demands, and this water shortage is causing chaos and water use conflicts. Mbonile (2001, 2005) reported a number of water use conflicts along the PRB. They include conflict between communities and conservation organizations, upstream and downstream water users, hydroelectricity plants and other water users, farmers and livestock keeper, rural dwellers and urban communities, and communities and river basin authorities.

Land and Water Deals in Tanzania

Results on land and water deals presented in Table 11 are just indicative examples representing few cases of the major problem prevailing in the country. These examples focus much on biofuel and food crop investments. Other land deals in Tanzania (which are not in the table) focus on carbon sequestration projects under the umbrella of reducing emissions from deforestation and forest degradation (REDD) and clean development mechanism (CDM) initiatives.

Land and water grabbing highlighted in this study not only reveal a sign of poor knowledge of local communities over their resources, but it indicates the extent of corruption among our leaders. Some of the leaders responsible for safeguarding natural resources conspire with investors in order to violate regulations, guideline, and laws that guide proper land and water utilization. In some case, even clauses stipulated clearly in the 2002 National Water Policy, 1995 Land Policy, 1999 Land

Use Act, and 1999 Village Land Use Act are bypassed in favor of foreign investments. Land and water grabbing in Tanzania are an example of the validity of the applicability of classical economic theories (Harvey 2003) on wealth appropriation through "primitive accumulation."

Primitive accumulation in the PRB involves depriving poor smallholder farmers of their fertile land in the name of boosting the local economy through capital investment. Letting fertile land and water to foreign firms (Table 11) is a testimony of the operationalization of the Marxist theory of accumulation by dispossession (Harvey 2003). In the PRB, there are transfers of factors of production (land and water) from the majority (poor Tanzanians) to the few (foreign companies). What is actually going on is the transfer of sources of income from smallholder farmers to few who claim themselves as investors. In economic terms, this situation is like taking away sources of income from the majority (smallholder farmers) to the minority without creating new investment. Water and land grabbing in the PRB are like "the conversion of various forms of property rights into exclusive private property rights" (Larsen 2012). In a nutshell, land and water grabbing in Tanzania are another form of capital accumulation through neocolonialism dubbed as "accumulation by deprivation." It is a new neocolonial approach in disguise aimed at plundering natural wealth from developing countries.

Conclusion

Foreign investments have potential contribution to the development especially where the central government and private sector lack sufficient capital and skilled labor. Nevertheless, the current chapter has demonstrated that these foreign investments are exploitative in nature and influence water grabbing along the PRB. The significant influence of water grabbing on crop yield before water grabbing is an indicator of the negative effects of foreign investments to smallholder irrigators. This testifies that the perceived positive expectations from these investments are outweighed by the actual negative outcomes.

This chapter has revealed that drivers for land and water grabbing displayed are influenced by policy failures, poor governance, and lack of commitment among officers responsible for laws and regulations enforcement. Therefore, these negative outcomes and failure to oversee their responsibilities call for enforcement of policies, laws, and bylaws in order to offset the drivers and negative effects of land and water grabbing. Contracts signed between the government and foreign investors don't adhere to clauses outlined in national policies. Furthermore, these contracts are violated and increasing corruption sums up the problems facing land and water deals. Adjusting land laws, policies, by-laws and enforcing them to benefit smallholder farmers would bring about a win-win situation between villagers and foreign investors. This would also remove features of neocolonialism (e.g., land alienation, forced labor, bad working conditions, and discrimination) which are witnessed in majority of large-scale plantations along the PRB.

Investments involving land and water in Tanzania have so far created more problems (conflicts) than the expected benefits (such as employment and community welfare). Majority of foreign investments has jeopardized the security of tenure and the national interest as well. Lack of transparency and accountability in contract negotiations has created loopholes for corruption. Based on the above results and discussion, I recommend enforcement of Land Policy, Land Use Act, and the Village Land Act; implementation of investments aimed at improving food security; transparency in land acquisition; and investments that aim at ensuring the social security and remove vulnerability to water grabbing problems. Furthermore, I recommend foreign investments to assist local communities to explore groundwater, rainwater harvesting, and construction of water reservoirs.

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