Prospective oil and gas resources and its relation to potential insurgencies: New insurgency impending in South Eastern Sudan?¹

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Abstract

The current studies of insurgencies and natural resources usually only take into account the produced/proven oil reserves and do not apply the assumption of prospective oil resources. The combination of economic estimation of oil resources, undiscovered hydrocarbon resources and insurgency relating the economic potential within an oil prone area with conflict parameters on a disaggregated level have not yet been fully evaluated and understood.

This study evaluates if there were less insurgency prior to oil exploration and production and if the assumption of large prospective oil resources have any effect on new insurgencies. First is the oil resource increase of both the discovered and prospective oil resources in the Melut sedimentary basin in the south-eastern part of Sudan analysed, from the first discovery, Adar-Yale, in 1981 to the 2003 discovery of a giant oil field, the Great Palogue. The Great Palogue discovery opened for full development of an area earlier classified as an uneconomic oil province resulting in a 30 percent rise in the oil revenue income to the government of Sudan. Secondly, the oil resource increase is evaluated for its relation to insurgencies in the area based upon information both before and after oil was proven.

The preliminary results indicate that the last six year’s increase in proven resources in the Melut basin have also boosted the expectations of prospective oil and gas resources within the surrounding unexplored areas of the basin. The field development and the rapid oil resource increase within the region have resulted in a higher risk for clashes between the government of Sudan and different ethnic minorities within the Melut basin. The rivalry between these ethnic minorities shows also an increasing trend of tension.

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The Earth is not running out of hydrocarbon resources - at least for the near future - but the ability to explore for, and produce, those resources is being restricted in many regions by competing land use, as well as political, and environmental issues (IYPE, 2006). The exploration companies shift now from mature oil provinces in political stable regions of the world to more unstable areas. Most of the recent exploration in unexplored areas is in regions with at least one of the following characteristics: rough climate, difficult terrain, fragile government, local insurgencies (e.g the Arctic, Chad, Sudan, Bolivia). These areas are normally short of infrastructure both for exploration and production and the areas could also be already settled by other interests (e.g agriculture, town settlements). Large investments need to be provided for development of infrastructure when a discovery is proven and before the first oil can reach the market. Multinational oil companies start to explore in a region based upon a belief of presence of oil, which can generate large profits. The assumption of future oil profit from an area could trigger new insurgencies in developing countries with fragile governments and a history of armed conflicts, as warring parties aiming to capture or disrupt extraction and production in order to gain a strategic advantage against their opponent. The degradation of the physical environment of natural resource exploration based upon land use conflicts resulting in insurgencies are wide. Ecuador accused oil giant Texaco for the latter’s human rights and environmental abuses in the Oriente region of Ecuador (O’Donnel, 2004). The large British-based mining company Rio Tinto PLC, established in 1960 a copper mine on the Papua New Guinea island of Bougainville. This venture necessitated displacing villages and destroying large amounts of rainforest resulting in massive environmental torts and cultural degradation, war crimes, crimes against humanity, and massive human rights abuses stemming from Rio Tinto’s mining operation and the civil war it sparked (Matthew, 2000) Other examples include Omai Mine in Guyana (1995) where cyanide slurry were released into the Essequibo River; and El Porco in Bolivia (1996) where tailings were deposited up to 300 km downstream in the Pilocomayo River (Bridge 2004).

The relationship between oil resource insurgencies has been reported in several regions of the world. Alleged human right abuses of local citizens in the vicinity of oil exploration and oil installation areas committed directly or indirectly by multinational oil companies are reported. Exxon Mobil Corporation have been accused in acts of torture, rape, and murder committed over
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a period of years by its plant security detail in Aceh province, Indonesia. Indonesia’s brutal military dictator gave exclusive access to the natural gas deposits, which was one of the most profitable natural gas projects in the world, until 2001 (O’Donnell, 2004). Le Billon (2001a) examined the significance of the political economy and geography of two valuable resources, oil and diamonds, for the course of the Angolan conflict and the results indicated that greater corporate and international responsibility during wartime and transition to peace are essential in preventing and shortening potential conflicts.

This article combines geoscience knowledge and social science to evaluate the relationship between prospective oil resources and insurgencies, as shown by historical insurgencies and the historical estimated proven reserves. This study evaluates if there were less insurgencies prior to oil exploration and production in the region and if the assumption of large prospective oil resources have led to an increase in both the intensity and frequency of insurgencies. The study is using the Upper Nile state of Sudan as case study and relates it to the more oil developed Western Upper Nile state.

The focal region, the Upper Nile state in Sudan, is selected for six reasons, which will be discussed in details later in this paper: (1) The discovered oil resources have increased rapidly the last 10 years, turning the region from an agricultural to a petroleum production province; (2) The region is situated south of the previous north-south border, where the north is controlled by the Muslim-driven government, while the south is controlled by various ethnic minority groups (Christian, animists and Muslims). However, the majority is Christian (3) The Upper Nile state had low infrastructure (all-weather roads were constructed in the initiative fase of the oil development) prior to oil exploration and production. The new roads were in conflict with settlements and farmland; (4) The 2005 peace agreement between Sudan People’s Liberation Army (hereafter SPLA) and the Government of Sudan (hereafter GoS) indicated that the oil revenues generated from the South Sudan region are to be divided equally between the GoS and the Government of South Sudan (hereafter GoSS). This resulted in a significant increase in the income to the Government of South Sudan, with a simultaneous reduction for the GoS; (5) The 2005 peace agreement is brittle as several armed conflicts within South Sudan have been reported; (e.g the December 2006 clash in Malakal, Upper Nile state, between South Sudan...
Defence Force (hereafter SSDF) and SPLA resulted in 86 deaths (ST, 2006d)) (6) The production of the Great Palogue oil field started after the peace agreement and boosted the production levels and income of about 30%.

Insurgencies related to oil resources
Several recent studies of civil war have pointed to natural resource endowment as a factor facilitating and even generating conflict. The debate on resources and insurgency was initiated predominantly by Collier and Hoeffler (2002) after their econometric study work enterprised by the World Bank giving a development economist’s perspective on the origins of post–World War II civil wars. Their statistical analysis indicated that oil resources in countries such as Angola, Sudan, and Indonesia have motivated violent secession attempts. Their results implied that the strongest predictors of civil war onset were, among other factors, oil resources, dependence on primary commodity exports and poverty. However, regarding Collier & Hoeffler’s (2002) results, available systematic empirical studies have not fully succeeded in providing convincing evidence for the relationship between natural resource abundance and territorial conflicts. The initial excitement about the significant and large effect of natural resources on risk of conflict has tapered off as other researchers with other methods and model specifications failed to confirm these results. Elbadawi and Sambanis (2002) tests whether the same factors that explain war onset also explain the prevalence of civil war. They find that (their main findings) indicating that the economic studies of civil war onset and duration have underestimated the effects of ethnolinguistic fractionalization and democracy. Both Fearon and Laitin (2003), who tested 122 wars onsets between 1945 and 1999 against an oil export dummy variable and de Soya (2002), who linked 138 state measurements from 1989 to 1999 with a conflict onset dataset (>25 deaths), found that being an oil exporter increases the likelihood of conflict. Fearon (2005) indicated that oil exporters do seem to have been more disposed to civil war onset, but conclude that it is not yet clear what the most important mechanisms are.

Ross (2004) concludes that evidence supports the notion of availability of natural resources facilitating rebel effort once conflict has started. He introduces “booty futures” meaning rebels selling future resource exploitation rights to foreign companies or states). It is

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possible that this is common, however, only the civil conflict in the Democratic Republic of Congo (in 1997) is a clear case of a conflict in which booty futures in oil helped finance a rebel group’s start-up costs. Ron (2005) also state that resource abundance can create low-capacity states that are vulnerable to rebel challenge. Humphreys (2005) indicate that poverty and primary commodities do not in and of themselves cause civil war, but serve as entry points for policy makers seeking to prevent, defuse, or end conflict. Collier&Hoeffler (2005) indicate that the starting point is transparency in the reporting of oil revenues, to ensure that they actually flow into the budget and later to make the expenditure side of the budget transparent. Hegre & Sambanis (2006) found that several results from previous studies on civil war onset are highly sensitive to small changes in the model specification and conclude that models need to be tested with close related but differently measured variables before causal inferences are made.

The current studies of civil conflicts and natural resources have only taken into account the produced/proven hydrocarbons and not the assumption of prospective petroleum discoveries. Humphreys (2003, 2005) has assembled a dataset including volume of oil production and oil reserve estimates since 1960. His results indicated that oil production increase the likelihood of war, while oil reserves have no significance. However, the oil reserve estimate variable was only given on country level and is not disaggregated into each sedimentary basin within the country. I would argue that the spatial locations of the oil resources and its value estimates are vital for evaluating local insurgencies.

The introduction of GIS in conflict studies has rapidly evolved the study from national level analysis into disaggregated level analysis where most of the available information is spatially derived. Buhaug & Lujala (2005) applied GIS to generate precise measures of space-varying explanatory factors for civil war and demonstrated that country level statistics are poor approximations of the conflict zones. They stated that the sub-national variations need to be controlled as there might be deviations between national-level statistics and conflict-specific characteristics. African civil wars, 1970-2001, were used by Buhaug & Rød (2005) to identify spatial clustering of conflicts using GIS as a tool to generate sub-national measures of key variables. Among the findings was that the risk of separatist wars in Africa is increasing with proximity to oil fields and local dominance of a minority language. Lujala, Rød & Thieme (2006) introduce a new dataset, PETRODATA, which includes 890 onshore and 383 offshore locations with geographic coordinates and information on the first discovery and yearly production. Their
study indicates that oil and gas located in conflict area lengthen conflicts. The spatial distribution of the onshore locations within countries could indicate which part of the country the resources are situated and could cause clashes.

There have been relatively few published articles concerning the combination of economic estimation of oil resource, undiscovered hydrocarbon resources and territorial conflicts. So far, have I not come across any scientific papers evaluating the relationship between economic estimation of oil resources, undiscovered hydrocarbon resources and insurgency relating the economic potential within an oil prone area with conflict parameters on a disaggregated level.

Political and economic instability in petroleum proven regions
Political and economic events in a host country can have a significant effect on the long-term profitability of foreign direct investment projects of both the host government and multinational companies. For multinational companies, efforts are often made to quantify the possibility (or probability) that economic, financial or political events will affect the business climate in such a way that investors will lose money or not make as much money as they originally expected (Howell, 1998 and Hegre et al., 2001). Several predicting tools for international investments analyzing the financial, economic and political environments in countries are available, such as the International Country Risk Guide (ICRG) and Center for International Development & Conflict Management (CIDCM).

The Peace and Conflict series indicate that Sudan has a low peace building capacity and have ongoing wars. The human security has been low the last 10 years and the government has discriminated over ten percent of the minorities. Sudan is governed by an autocratic regime that
The insurgencies in Sudan, 1972-2006

Sudan is an ancient country, once incorporated in the Egyptian empire. Under the English colonial rule, Sudan gained its independence in 1956 and started as a democracy, but quickly slid into autocratic rule (Johnson, 2003). Numerous coups and civil wars have stained Sudanese history since as Sudan is one of the most conflict ridden countries in the world and has had civil war more or less continuously since its independence in 1956 (CSCW, 2006). The north/south cultural differences together with other social, economic, and political factors have plunged Sudan into one of the most violent civil wars in modern history. A closer look on the major ethnic groups is needed before the insurgencies within South Sudan region are explained.

South Sudan consist of several ethnic groups and the 4 largest are in decending order: Dinka, Nuer, Shiluk and Equatorian (collective term). The Dinka (2 mill people) are a group of tribes of south Sudan, inhabiting the swamplands of the Bahr al-Ghazal region of the Nile basin, Jonglei and parts of southern Kordufan and Upper Nile regions. They are a mainly pastoral people, who subsisting on cattle herding and millet growing The Dinka have no political center and have not shown any tendency to unite either politically or military (Johnson, 2003). The second largest minority group in South Sudan is the Nuer situated in the south-eastern part of Sudan on the border against Ethiopia. The Shiluk, the third largest ethnic group of South Sudan, lives on the west bank of the Nile around the city of Malakal and most of them are Christian. Their livelihood is based upon of cattle, agriculture and fishing. The Equatorian ethnic groups are concentrated in the far south region named Western Equatoria, Eastern Equatoria and Bahr Al-Jebel. In the first years after independence, the Equatorians held most positions among government clerks, police and soldiers in the South. These four main ethnic groups have for centuries struggled within South Sudan over land and cattle (Johnson, 2003). Later, with the development of the Sudanese state, these ethnic groups have moved violently to gain control of strategic positions within the South Sudan authorities.

Sudan has been exposed for domestic wars almost entirely since its independence in 1956. The first civil war in the Sudan started in August 1955; six months before the country gained its independence and lasted till February 1972, when both parties agreed on peace in Addis Ababa. Prior to the peace agreement the south was dependent on funding from the GoS. According to the peace agreement the GoS ended the funding of the south as they left the control of the mineral
resources to the GoSS. The latter was to prove tragically significant later. The issue of the Southern Region’s borders became evident with the issue of oil and economic development after the first onshore oil was discovered in early 1978 (Johnson, 2003).

The GoS used the tactic of divide and conquer with the ethnic minority groups to keep control over South Sudan. The blunder of the GoS in the Addis Ababa peace agreement in 1972, was giving the GoSS control over all mineral resources. The discovery of oil in 1980 on the southern side of the north/south border increased the political tension in the region as GoS tried to re-divide the South resulting in weakening the South political strength. The international factors was also dominant for the insurgencies as the United States of America (hereafter US) acted as a ideological regional counterweight to Soviet-backed Ethiopia and the US used Sudan to carry out joint military actions on Sudanese soil related to Libya, while backing up Chevron’s oil exploration campaign. Before the Addis Ababa agreement the GoS realized that the war in the South could not be solved military. In the beginning of the 1980’s US supplied Sudan with arms meant for protecting Sudan against Libya and Ethiopia. However, the first place these arms were used was in the South, where the South was supported with arms from Ethiopia.

The development of SPLA, in 1983, united the majority of armed forces in South across ethnic groups, and was predominantly established to change the underdevelopment of the South after independence and the GoS’ attempt to establish a Sudanese national identity based upon Islam with a sharia legal code, Arabic language and culture. The SPLA struggled both against the remaining rebels not willing to unite and the army of the GoS. The SPLA consisted predominantly by Dinkas which led to several clashed with the Equatorian tribes.

In late 1984 the GoS (led by Nimairi) started to supply the Nuer with arms and equipment to fight the Dinka-led SPLA. This enabled, among other things, Chevron to exploit its fields in Upper Nile (Adar-Yale field).

The second war started when the central government abolished the Southern autonomous region and made shari’a (Islamic law) the law of the land in 1983. The second war turned also its direction towards the GoS’s plans to locate the pipeline through the north, to build a refinery in the north and that all profits moved from the south to the north. The development of SPLM/A called for a united, secular Sudan.” The Islamist-military government that took power in 1989 was determined to develop Sudan’s oil
Exploration for oil in Sudan began in the late 1950s and was largely conducted offshore in the Red Sea (Klitzsch, 1994). In the 1960s several intensive studies of the onshore sedimentary basins resulted in a book summarizing the geological knowledge at that time (Whiteman, 1971). This book was used as a fundament for further exploration for minerals, hydrocarbons and water resources in Sudan. Chevron Overseas Petroleum Inc. started onshore petroleum exploration efforts in previously unexplored Sudan in early 1975 by air magnetic survey followed by a gravimetric survey identifying major sedimentary structures. Their first exploration drilling program began in October 1977 within the Muglad basin in Western Upper Nile state (Schull, 1988).

**Oil development and clashes in Unity and Heglig field regions, Muglad basin**

First oil in the Muglad basin was discovered north of Bentiu in 1978 proved the existence of an oil province. This lead to a significant exploration program leading to the first significant discovery, Unity, in 1980 and the Heglig discovery in 1982 (Schull, 1988) Prior to the first discovery government troops and horsebacked militia of the Baggara, Arabized cattle nomads of Darfur and Kordofan, crossed the north-south border of Sudan and invaded from the northwest, destroying communities and expelling much of the population (Dinka and Nuer) from the initial exploration areas (HRW, 2003). One year after the outbreak of the second war, in early 1984, SPLA (Dinka and Nuer militias) raided the Chevron base of Rub Kona, near Bentiu, resulted in the suspension of Chevron’s activities in Sudan. In 1988 Chevron had drilled a total of 86 wells in Sudan, where 79 were located in the Muglad basin, mainly in the Unity and Heglig areas. The remaining wells were drilled in Melut basin, five wells, and one well each in the Bagarra and Blue Nile basins.

The oil development re-started in 1991 after the withdrawal of Chevron from Sudan in 1990 and in 1992 was the enormous Chevron concession sub-divided into smaller concessions. Chevron ended its 17-year involvement in Sudan in 1992 by selling its upstream holdings of 42m acres to the Concorp, a Sudanese Company, for US$25m after spending US$1 bn on the concessions. In late 1992 Concorp sold the Chevron concessions to Arakis Energy Corp. In January 1993 Arakis indicated that its concessions contained 1.4bn bbl oil where 280m were proven recoverable. The concession has a potential to develop additional 3.5bn bbl, which
international analysts indicate are exaggerating recoverable reserves (SudanUpdate, 2006). In 1994, Total, a French oil company, suspended all activities and withdrew after 14 years in Bahr al-Ghazal province, while Arakis gained control of the Sudan concessions in Unity and Heglig. During the 1990s did the GoS start with a divide and rule strategy to further destabilize the area supporting the Nuer with arms used in clashes with Dinka. These campaigns of killing, pillage, and burning by the government troops and their southern allies prepared a fundament for developing the basic infrastructure for oil extraction and transportation (HRW, 2003). A United Nations report published in 1999 “gave details of fighting that it claimed has resulted in the flight of 3,000-4,000 civilians towards southern Sudan, after government forces cleared an area around the oil fields with the help of bombers, helicopter gunships, and artillery” (OGJ, 1999). The field development of Unity and Heglig fields with additional exploration in the intimate regions was performed by the Arakis resulted in the first oil production in 1996. Arakis announced in 1996 that its fields had probable and proven reserves of 600m barrels. The company entered into a consortium, the Greater Nile Petroleum Operating Company (GNPOC), as it was unable to finance exploration, development and pipeline as a single company. Sudan became an oil exporter in 1999 as the 1,540-km oil pipeline to the Red Sea, Port Sudan, was completed (Petroleum Economist, 1999). GNPOC (2006) indicated that the consortium have as of April 2000 a total of 73 exploration wells (41 wildcats with 27 discoveries) drilled within the GNPOC exploration area, blocks 1, 2 and 4. The consortium held in 2000 a 50000 sq. km exploration area, with 10840 km 2D seismic and 3D seismic covering 1445km2. Major oil production in Sudan started in June 1999 after the completion of 1504km pipeline system from the Heglig Field connected via the surrounding fields to the harbour of Port Sudan. 461 mill bbl have been produced by the end of October 2004 from the 8 fields in the Heglig and Unity concessions (1&2): Heglig, Unity, Toma South, El Nar, El Toor, Bamboo, Munga and Diffra (ARB 2003).

Exploration in the surrounding areas of Unity and Heglig fields boosted as the oil export infrastructure from central Sudan was completed in 1999 turning even small discoveries economic. Concessions 5A and 5B, southeast of Bentiu, will be important future production areas to continue high production rates as new discoveries are tied to the existing pipeline (Petroleum Economics, 2003). Rebel groups such as SPLA and Nuer gerillias, impeded the construction of the oil road were strong as the exploration moved from the north/south border to the floodplains.
of concession 5A operated by Lundin, a Swedish firm (HRW, 2003). The first oil from concession 5A, Thar Jath field, was produced April 2006 (Gulf oil&gas, 2006)

Oil development and clashes in Melut basin

The first oil discovery in the Melut basin, Upper Nile state, Adar-Yale field, was discovered in 1981 by Chevron, on the plains east of White Nile predominantly Dinka area (Schull, 1988 and ECOS, 2006a). It was first estimated to hold 168 mill bbl oil in place and considered not being commercial due to the high investment burden of long-distance pipeline to the sea (Xiaoguang and Buqing, 2006.). One year after the outbreak of the second, in early 1984, SPLA raided the Chevron base of Rub Kona, near Bentiu, in resulted in the suspension of Chevron’s activities in Sudan. The oil development re-started in 1991 after the withdrawal of Chevron from Sudan in 1990 and in 1992 was the enormous Chevron concession sub-divided, which resulted in the introduction of Gulf Petroleum Company –Sudan (GPC) consortium to blocks 3 and 7 of the Melut basin (Patey, 2006). The first sign of problem relating to oil area was in 1991 as the GoS army chased people without warning in the surrounding area of the Adar-Yale field. This was the beginning of high intensity armed clashes where the GoS raided the area in the dry seasons. This GoS displacement tactic using threats, imprisonment and torture has been prominent until July 2003 as the Protocol on Security Arrangements was signed September 2003 between GoS and SPLM/A (ECOS, 2006a). In 1996 GPC invested US$12m in developing the Adar-Yale field and started small scale production as the transportation was by trucks. River shipments have been subject to Sudan SPLA attacks. However, CNPC estimates that, with improvements in the security situation, production levels of 160,000 b/d can be achieved as the potential resource estimates in Blocks 3 and 7 is of 1bn bbl (Petroleum Economist, 2003)

In 2000, a joint company, Petrodar Operation Company (PDOC), was established with China National Oil and Gas Exploration and Development Company (CNPC) boosting the exploration in the concessions. The seismic acquisition improved the oil in place to 276 mill bbl. In, 2001, additional 129 mill bbl was added as three surrounding oil pools were discovered. However, still the concession was classified as non-commercial based on the pipeline construction costs.

In October 2002, CNPC drilled a large anticline north-west of Adar-Yale field discovering one of the few giant oil fields in the 21st century, The Great Palogue field. The field
is estimated to hold 2.9 billion barrels of oil, where 600 mill bbl are recoverable (20%). This
discovery turned the concession to be classified economic and the 1349km 32 inch pipeline
started oil transport to Port Sudan in April 2006 (IOL, 2006). The new pipeline increased the total
Sudan oil export from 450,000 to 600,000 bbl oil per day (bopd).

The total reserve estimates of the Melut (concessions 3 and 7) have increased from 168
mill bbl of oil in 1981 to over 3.3 bill bbl of oil after the Greate Palogue Field discovery and now
contributing about half of the total in place oil resources in Sudan (Fig. 3).

![BP statistical Review of world energy, proven reserves in Sudan](image)

Fig. 3. The proven reserves of the Melut basin in Sudan show a large increase in proven reserve
estimates since the first discovery in 1981 to the Greate Palogue discovery. The Melut basin is
now estimated to contain about half of the total proven reserves in Sudan estimated by BP
statistical review of world energy (BP, 2006).
Fig. 2 provides a regional map of Sudan indicating the geographical distribution of sedimentary basins with concessions, oil exploration and production in the Sudan, including the Port Sudan pipeline. The traditional north-south boundary (Adapted from USAID, 2002, RIGHTSMAPS, 2002) are also shown. Concession holders are updated from (Schikor, 2005; Fee, 2006, ECOS, 2006b), while the sedimentary basins updated from (Xiaoguang and Buqing, 2006).
The 2005 South Sudan Peace agreement

On January 9, 2005, the GoS and the Sudanese People’s Liberation Army (SPLA) in the South signed a permanent peace accord, ending Sudan’s 21-year civil war (ICG, 2005a). This final comprehensive peace agreement was a culmination of more than two years of intensive negotiations (ST, 2005a). The peace pact covers all the eight peace deals signed previously, including earlier agreed protocols on how to share power and natural wealth, what to do with armed forces during a six-year transition period, how to administer three disputed areas, and the latest on permanent ceasefire and modalities of implementing peace deals (ST, 2005f): (1) Religious freedom: The 10 states in Southern Sudan will be secular, while the north will practice Islamic law; (2) Power sharing: Former rebels will hold 30 percent of national posts for Sudan as a whole, the South will be autonomous; (3) Wealth sharing: Oil revenues from the south will be split 50-50 between the GoS and GoSS; (4) Southern self determination: The south will vote on independence in 2011; (5) Monitoring: U.N. observers will monitor a cease-fire and demobilization of troops. According to the signed agreement, the border separating the north from the south are similar as to the one defined on 1 January 1956...Just days after the peace deal a former Sudanese prime minister, Sadiq al-Mahdi, indicated that the peace deal could spark more conflicts as: "If you say the goodies, the benefits, are going to be simply handed out according to military pressure then you are going to get mounting military pressures which ultimately will divide the country up" (ST, 2005e)

The peace deal was assumed to bring large economic opportunities for neighbouring countries and others entrepreneurs in the approximately 850,000 sq. km Southern Sudan. The crucial ingredients for stability in the delicate phase following the signing of the peace pact were a rapid start of the reconstruction activities and an active involvement in Sudan by the donor community (ST, 2005e). The comprehensive peace accord would unlock the massive natural resources in southern Sudan, which had previously not been exploited because of the war. (ST, 2005e). However, the implementation of the CPA has been hampered by the lack of good faith and the absence of political necessity on the part of the ruling National Congress Party (NCP) and the lack of capacity of the SPLM/A, aggravated by the July 2005 death of its late Chairman, Dr. John Garang (ICG, 2005)
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Insurgency indicators in the Melut Basin

The oil sector continues to be a high-risk area for the implementation of the agreement. The GoSS is to receive 50 per cent of all revenue from oil produced in southern Sudan, after 2 per cent is set aside for the relevant oil producing state government. Still, the parties do not yet agree on the parameters for calculating the oil wealth, or which oil fields lies in the South. In addition it has not yet been any progress on defining the North-South borders which will determine the division of the oilfields (ICG, 2006).

Several armed conflicts within South Sudan have taken place since the 2005 peace agreement. The Government of South Sudan accuses north troops, the SPLA and Ugandan troops for raiding South Sudan towns and transport lines (ST, 2006a). On the opposite side deny Sudanese army the arrest of 15 soldiers by the SPLA (ST, 2006e). The largest clash after the peace agreement was December 2006 clash in Malakal, Upper Nile state, between South Sudan Defence Force (hereafter SSDF) and SPLA resulted in 86 deaths (ST, 2006d)). Other internal disputes within the Upper Nile state is also present as Nuba and two Equatorian ethnic groups, in December 2006, signed a memorandum of understanding due to mismanagement of Southern affairs by the SPLM party (ST, 2006c). An analysis of in Sudan Today (2006) indicated that the GoSS dominated by SPLM has not followed up the important aspects of the CPA, such as the Petroleum Commission, the Lands Commission and the North-South Borders Commission. According to Ministry of Finance (2006), GOS, the expected oil revenue to GOSS in 2006 is expected to be 1400 mill $US, which give approximate 110 mill $US per month, where about one third of the revenue is derived from the Upper Nile region. In addition, The World Bank (ST, 2006) indicated in November 2006 that the Government of South Sudan has enough money from the oil revenue to build up social services as the South Sudan oil revenue rises to mill US$865. The GoSS 2006 budget indicated that 40% of its oil revenue is to be used on military defence issues (Minister of Finance 2006), money that could be used for development of the region.

Indications that the Upper Nile State has similar problems as the war afflicted Western Upper Nile (Muglad basin) are; (1) the region is situated south of the previous north-south border; (2) oil-related deaths, destruction and displacement; (2) oil exploitation has coincided with a decline in the rural population and the oil production generates large amount of money, still, the region remains extremely poor with negligible service levels; (3) Environmental damage caused by the oil development program
Prospective resources and its application to potential insurgencies in Melut region

Possible prospective oil resources in the Melut region are to be found in the surrounding areas of the existing oil fields and exploration wells where the sedimentary basin is present. Based upon the assumption that the largest oil fields within an area are discovered first, only minor fields are to be discovered within the Melut basin. The possibility of an economic discovery is quite high as the sedimentary basin is an onshore field, making the exploration and drilling cheaper than offshore exploration. The production cost is also kept to a minimum as the infrastructure now is present (transport pipeline, all-weather road etc.)

Based upon the exploration history in Melut basin it could be assumed that the GoS will use similar tactic as before to displace settlements in exploration area resulting in a potential for new insurgencies. Xiaoguang and Buqing (2006) indicated that the reserve estimates of both Muglad and Melut basins will most likely increase as large part of the basins are underexplored. It could be assumed from this assumption that new areas will be utilized for oil exploration.

The internal insurgencies between the different ethnic groups (Dinka, Nuba and Equatorian ethnic groups) within South Sudan could hamper the peace agreement and the development on an independent South Sudan. External factors, such as the resistance of the GoS wanting to disrupt the peace process to benefit for a larger share of oil revenue. Destabilisation effects from neighbouring countries (predominantly Uganda and Ethiopia) could also have an effect.

Other areas within South Sudan with oil prospective resource, which can generate insurgencies is concession 5 central, just south of concession 7, Melut basin. TotalFinaElf, now Total, held the largest concession in southern Sudan, concession 5 (central). Total had carried out 2D seismic survey and airmag-survey in the early 1980s and three wells were planned drilled in 1985, but the concession has been abandoned since 1985 because of insurgencies. This claim was renewed by the Sudanese government in 2004 (Total, 2006). The seismic survey was reprocessed in 2004 as the peace agreement between GoS and the SPLM was signed (Total, 2004). This concession is the largest oil concession in Sudan and could hold large undiscovered oil resources. However, no wells have been drilled yet. (Fee, 2006). The possible development of this area, if oil is discovered, could trigger conflicts with similar magnitude as Unity/Heglig area and Melut
basins. The threshold reserves for developing the area is low as the current pipeline from Melut to Port Sudan is dimensioned for increase in production (ST, 2006f).

Conclusions

This study has pointing out relationship between geoscience knowledge and social science, where both proven reserves and prospective oil resources has been related to insurgencies.

The ethnic groups within South Sudan have struggled for centuries for land and cattle and later for positions in the local government and portion of the oil revenue. For decades has the GoS used a divide and rule tactic to keep control over South Sudan. The blunder of the GoS in the Addis Ababa peace agreement in 1972, giving the GoSS control over all mineral resources, and the discovery of oil in 1980 on the southern side of the north/south border increased the insurgency in the region. Almost 20 years of war was replaced by the 2005 peace agreement, where the oil revenue is equally divided between GoS and GoSS, resulted in a decrease in armed clashes.

The analysis, which was carried out by a case study analysing the Melut sedimentary basin in Sudan with a comparable study of the Unity/Heglig field area, produced some promising findings. The general trend of oil exploration and production in Muglad and Melut basin is devastating. Throughout the development of the onshore oil reserves have the GoS army and its allies moved settlements and entire ethnic groups from the exploration/development area leading to . The tension has been levelled of as the field development was finished. This could be influenced by the 2005 peace agreement. However, the peace agreement is fragile as the oil revenue is spent on military issues instead of development of South Sudan. Based upon the case study it could be concluded that exploration for oil in new frontier areas will lead to clashed as the government soldiers making the way for oil exploration. The peace agreement can, however, prevent insurgencies if all fractions of both government and ethnic groups are be of the same opinion.

The analysis also uncovered the importance to understand the relationship between further oil profit and insurgencies, which is socially useful as it could be used for early warning of potential insurgencies.
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