A General Model of Natural Resource Conflicts: the Case of International Freshwater Disputes

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A General Model of Natural Resource Conflicts: the Case of International Freshwater Disputes. This article begins by summarizing social scientific perspectives on the connection between natural resources and conflicts. From these theoretical perspectives, a number of key concepts are identified and defined. These key concepts are then integrated into a general model which speculates on the connections between them and conflicts over natural resources. Finally, an analysis of cases of international freshwater disputes and more specifically the dispute between Slovakia and Hungary over the Gabčíkovo-Nagymaros dam on the Danube River is used to assess the utility of the general model of natural resource conflict.
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Introduction

In the current global context of increasing consumption, growing populations, and declining availability of many natural resources, numerous analysts have predicted that disputes over natural resources such as water, timber, and oil will become more common. Conflicts over natural resources are likely to occur in various contexts, from local disputes over a shared water hole to inter-national disputes over clean air regulations. Theories from social science over the last two centuries provide insight and explanation regarding the sociological, political, and economic factors that can be used to understand or perhaps predict the contexts in which conflict over natural resources is likely.

This paper provides a review of important social scientific literature that pertains to natural resource conflict, and further provides a detailed discussion of relevant concepts and their definitions and dimensions. Building from the theories of classical and contemporary scholars, a general model is presented which will assist scholars and policy makers in understanding the issue of natural resources conflict. The topic of international water disputes is used to illustrate the utility of the general model. Finally, an application of the general model to the case of the Gabčíkovo-Nagymaros dam dispute between Slovakia and Hungary is presented.

The Social Science of Natural Resource Conflict

Traditional Malthusian theory suggests that–due to population growth–human consumption needs will eventually exceed the availability of natural resources (particularly food), causing a myriad of negative social outcomes like war, disease, and famine (Malthus, T., 1798). Violence and war, from the Malthusian perspective, are "positive checks" that serve to re-establish the equilibrium that is disrupted by scarcity caused by population growth. According to Price, Malthus's theoretical statement is, simply, that population expands to the limits imposed on it by subsistence (Price, D., 1998). The inevitable results, however, when society reaches those limits are poverty and disaster. The traditional Malthusian perspective has been heavily criticized, however, for neglecting the role of technological innovation and other factors in increasing the carrying capacity of the world (for example, see Barnett, H. J., 1974).

Classical economic theories on society and natural resources have emphasized the creation of markets as the key to balancing positive development and over-consumption. Adam Smith (1937 [1778]) suggested that a distributive system based on supply and demand could bring about a dynamic society capable of effectively addressing scarcity. Simply put, as resources become scarcer their price goes up, thereby deterring over-consumption and spurring technological developments and substitutions. Perspectives critical of classical economics have pointed out that as natural resources become more scarce and their value goes up the financial incentive to further exploit those resources also increases–to the point where the result is often extinction, disappearance or devastation (Clark, C. W., 1973; Davidson, D. J., 1999). Trade in ivory, leopard skins, and rhinoceros horns, and the destruction caused to the species that give us these things illustrate this point. Furthermore, many criticize the vast potential for divergent accumulation of wealth under the free-market system such that some gain control over much while the rest have little (Trainer, T., 1998).

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Theories in the Marxist tradition have emphasized the conflicts of interest between groups with more or less control and ownership of natural resources. These approaches argue that free markets create such great disparities between the "haves" and the "have-nots" that social conflict is inevitable (Marx, K., – Engels, F., 1962 [1848]). According to M. N. Dobkowski and I. Wallimann (1998, p. 4), the economic transformation of the last two centuries has "always been financed on the back(s) of peasants both in the nineteenth century, in the area that is now known as the centre, and in the twentieth century, in the area now known as the periphery." Contemporary scholars in the dependency and world-systems schools have further discussed how wealthy nations exploit other countries for their natural resources (Baran, P. A., 1957; Chirot, D. – Hall, T. D. 1982; dos Santos, T., 1971; Wallerstein, I., 1979). Critics of Marxist approaches have included social Darwinists, who believe that social rewards are acquired based on merit or inherent ability (Spencer, H., 1883), and functionalists, who feel that social hierarchy is a requisite aspect of industrial and post-industrial society (Davis, K. – Moore, W. E., 1945).

In the classic sociological tradition, which emphasizes the effects of industrialization on human relations, Durkheim examined how macro-structural changes in human social organization affected social adaptability. According to Durkheim (1965 [1902]), population growth and its concomitant growth in competition for resources helped bring about the industrial era and the complex division of labour associated with it. Furthermore, Durkheim contended that the division of labour in complex society increases social adaptability, thereby reducing conflicts between classes and different segments of society (Harper, C. L., 1996; Humphrey, C. R. – Buttel, F. R., 1982). Marxists and other critical theorists have criticized the Durkheimian view that organic solidarity is a stabilizing force strong enough to prevent conflict between the classes.

The classical social science approaches, with the notable exception of the Malthusian tradition, have implicitly supported the notion that humans are more or less exempt from the natural limits to growth prescribed by a finite resource base. For example, classic economic approaches emphasize the point that free and open markets, along with human ingenuity, can overcome natural resource limits by redefining the resource base. Marxist and conflict approaches generally claim that the scarcity of resources is not what limits development but rather the inequitable distribution of these resources among the members of society. Furthermore, most classical sociological approaches, particularly those in the functionalist tradition, emphasize the importance of higher order social structures and institutions as key to the adaptability of societies.

Social scientific approaches which de-emphasize the limits that finite natural resources may hold on society are commonly labelled "human exemptionalist" or "human exceptionalist" paradigms (Dunlap, R. E. – Catton, W. R., 1979). Such perspectives are, in general, unlikely to claim that natural resource scarcity will directly result in social conflict and disorder in free-market, industrialized societies. Rather, "human exempt" approaches predict that scarcity can be overcome or is at most indirectly associated with conflict.

In the last half-century there have arisen several theoretical schools, which give more importance to the natural environment as a salient factor in social development. Shiva describes the belief that technology reduces human dependence on natural resources as a myth that overlooks the "long and indirect chain of resource utilisation which leaves invisible the real material resource demands of the industrial processes" (Shiva. V., 1991, p. 13). The "new ecological" approach (Dunlap, R. E. – Catton, W. R., 1979), which gives more importance to the natural environment as a salient factor in social development, argues that there are limits to growth and that human societies cannot rely on institutional and market adaptations to overcome these limits. Human ecologists were among the first to formally state a theory (the POET model), which includes the environment as a key variable, which interacts with social organization, demographics and technology. Environmental sociologists, along with various individual political scientists, economists, geographers and others, have, since the 1960's, stressed the importance of nature and society interactions. Specifically, they have posited that the deterioration of natural systems, like water, air and soil, could have negative effects on social, political, and ecological security.

Over the last decade or so, the field of environmental security has emerged to study the effects of environmental degradation and scarcity on international security. Although originally understood as the effects of environmental depletion and degradation on violent conflict, environmental security now commonly refers to *the relationship between the state of the physical environment and the general state of social, ecological, and political well-being in societies* (Dabelko, G. D., 1996; Græger, N., 1996; Homer-Dixon, T. F., 1999; Wolf, A., 1999). Political scientists have done substantial work on resource scarcity and other environmental threats to international security (Dabelko, G. D., 1996; Gleick, P. H., 1993; Gurr, T. R., 1985; Homer-Dixon, T. F., 1991; Homer-Dixon, T. F., 1994; Ophuls, W., 1977; Sosland, J. K., 1998; Swart, R., 1996).

T. F. Homer-Dixon (1999) claims that natural resource scarcity can cause conflicts due to its social effects. His conclusion, based on more than a decade of research on environmental causes of acute conflict, is that natural resource scarcity can cause conflict indirectly through its negative social consequences. The negative consequences of natural resource scarcity may include human migration and expulsion, receptivity to insurgency, decreased economic productivity, and a weakened state. Such effects increase the likelihood of 1) *simple-scarcity*

conflicts, where resources such as freshwater, land, or fish become so exhausted that the sheer lack of these resources causes groups to dispute the remaining shares, 2) *group-identity conflicts*, due to "the large-scale movements of populations brought about by environmental change (Homer-Dixon, T. F., 1991, p. 439)," and 3) *relative-deprivation conflicts*, which may occur as the ability of less developed groups to grow is diminished by environmental problems. In the global context of capital accumulation, such limits on development may cause discontent on the part of those relatively deprived. This discontent could potentially cause conflicts.

Within environmental sociology, Schnaiberg and Gould have posited a conflict oriented theoretical approach that specifies why groups may dispute natural resource issues (Schnaiberg, A. – Gould, A., 1994). According to Schnaiberg and Gould,

"The wide variation between the levels and types of ecological damage inflicted by the nations of the world guarantees that nations will come into conflict with one another over solutions to global environmental problems. Similarly, the wide variation among nations in terms of the distribution of benefits received from ecosystem withdrawals and additions will also necessitate conflict in the international arena (1994, p. 234)."

This theory is rooted in the authors' belief that the nature of contemporary economic production systems causes ongoing environmental disorganization, in the form of pollution and other latent impacts, as well as inequitable distribution of the benefits of such economic production. From the perspective of Schnaiberg and Gould, international conflicts over natural resources will occur as a result of trans-boundary pollution and degradation of commonly held resources as well as inequitable sharing of commonly held resources.

Table One presents a summary of the basic theories and key concepts introduced in the above discussion of social scientific theories on the interaction of society and natural resources. The theories speculate, in different ways, on the relationship between the decreasing availability and quality of natural resources and the level of social conflict, which may result from that.

Table 1: **Basic Social Science Theories on Natural Resource Conflict**

Approach	Basic Theory	Important Concepts
Malthusian Theory	Due to population growth, human consumption will eventually exceed the availability of natural resources, causing negative social outcomes like war, disease, and famine.	Population Growth Natural Resource Scarcity Social Breakdown
Classical Economic Theory (Smith)	A system based on supply and demand will bring about a dynamic arrangement capable of addressing scarcity. Scarcity deters over-consumption and spurs technological developments and substitutions, which support continuous growth of old and new sectors of the economy, thus minimizing the need for disputes over resources.	Economic Development Trade Innovation
Marxist Theory	Free markets create disparities in wealth, thus generating conflicts of interest between the "haves" and the "have-nots."	Social Inequality Conflict
Classical Sociological Theory (Durkheim)	Macro-structural changes in social organization affects social adaptability. Population growth and competition for resources result in an increasingly complex division of labour, which increases social adaptability and decreases conflict.	Social Adaptability Conflict Population Growth
Homer-Dixon Theory	Natural resource scarcity can cause conflict indirectly by causing social breakdown. Negative consequences of scarcity include human migration and expulsion, receptivity to insurgency, decreased economic productivity, and a weakened state.	Natural Resource Scarcity Social Breakdown Conflict
Schnaiberg and Gould Theory	Economic development causes social inequality and natural resource degradation and depletion, which will contribute to conflict.	Economic Development Natural Resource Scarcity Conflict

Concepts, Definitions, and Dimensions

The above section described several theoretical traditions that relate social and economic factors to conflicts over natural resources. The causal factors which can be extracted from those theories include 1) demographic change, 2) economic development, 3) natural resource scarcity, 4) social inequality, 5) social adaptability, and 6) social breakdown. All of these factors may cause natural resource conflict. Table Two provides a brief definition and the important dimensions of each of these concepts, and the following sections explain them in greater detail.

Natural Resource Conflict

Natural resource conflict can be broadly defined as *a dispute between groups who are competing for the control over, use of, or responsibility for natural resources*. There are many forms, which natural resource conflicts may take. These may include legal and political challenges, civil confrontations or in some cases violent clashes over natural resources. On the opposite end of a scale of conflict may be harmony or cooperation. Thus, we can conceive of natural resource conflict as a range of levels of dispute between groups, ranging from harmony and cooperation on one end to legal challenges, civil disputes, or violence on the other end.

Three dimensions of conflict should be considered. These are *intensity*, *duration*, and *scope* of conflicts. Intensity refers to the severity or quality of the conflict. A low intensity conflict could be simply a media dialog of disagreement between competing groups, while a high intensity conflict may include armed attacks. Duration of conflict refers to the length of conflict–whether it is over a period of a few days, months, years, or generations. Lastly, scope of conflict refers to the geographical area over which the conflict takes place. For example, conflicts may be local, national, or regional in scope.

Natural Resource Scarcity

Natural resource scarcity refers to *the extent to which valuable natural resources, like water, land, and fuel, are available for use by individuals*. Since it is difficult to specify the amounts of such resources that any given individual needs to thrive, we may speak of natural resource scarcity as a relative term. Some resources, like coal and oil, are considered non-renewable while others, like freshwater and forests, are considered renewable. The conceptualisation of natural resource scarcity intended here refers to the relative abundance of renewable and non-renewable natural resources. For example, as a resource is utilized, i.e. "used up," it becomes relatively scarcer. Further, as a resource becomes polluted or degraded, its availability for use is diminished and is therefore relatively scarcer. We may refer to these as dimensions of *depletion* and *degradation*.

Table 2: **Definitions and Dimensions of Concepts That May Predict Natural Resource Conflict**

Concept	Definition	Dimensions
Natural Resource Conflict	Broadly construed as dispute between groups competing for control over, use of, or responsibility for natural resources. It may range from harmony and	-Legal Challenges -Civil Confrontations -Violent Clashes

	cooperation on one end to civil confrontations and violence on the other end.	-Intensity -Duration -Scope
Demographic Change	Increases in the total number of humans present in society and increases in the number of people living in urban areas.	-Population Growth -Urbanization
Natural Resource Scarcity	The relative extent to which valuable natural resources, like water, land, and fuel, are available for use by individuals.	-Depletion -Degradation
Social Inequality	The unequal or inequitable distribution of resources and wealth between social classes, ethnic groups, or societies.	-Within and Between- Society Inequality -Ethnic Inequality
Economic Development	Refers to the increasing complexity and productivity of financial and industrial markets. Includes increases in manufacturing, consumption, distribution and living standards.	-Trade -Consumption -Production
Social Adaptability	The extent to which a society's institutions are prepared to deal with challenges and changes brought about by natural resource scarcity.	-Technology -Innovation -Education
Social Breakdown	The negative social consequences, which may be associated with natural resource scarcity.	-Migration/Expulsion -Receptivity to Insurgency -Decreased Economic Productivity -Weakened State

Demographic Change

Demographic change in this model specifically refers to *population growth* and *urbanization*. Population growth is simply an increase in the number of humans present within a geographical region. Rapid population growth exerts pressure on ecological systems and human infrastructure. Related to population growth is increasing urbanization. Not only is there a global trend of population growth in many societies, but also a greater proportion of individuals are choosing to live in densely populated urban areas. Urban life, which is further from the natural resource base, contributes to greater ecological withdrawals and additions, thereby contributing to natural resource scarcity.

Social Inequality

Social inequality, as it relates to this discussion, refers to the *unequal or inequitable distribution of resources and wealth between social classes, ethnic groups, or societies*. Within societies, a high degree of social inequality exists when a small elite class owns or controls the majority of resources while a large poor class owns or controls very little. Ethnicity is also often a source of social inequality, as ethnic heritage is sometimes a prerequisite for the ownership of resources; membership in the wrong ethnic group may mean preclusion from the accumulation of wealth. Lastly, between societies, social inequality may exist in terms of the extent of market control or natural and human resource exploitation. International social inequality is often conceived of as the relative position of countries in the economic core and periphery.

Economic Development

Economic development, as intended in this model, refers to *the increasing complexity and productivity of financial and industrial markets*. Included in this understanding is the development of trade markets and the generation of wealth by and for members of society. Conventional interpretations of economic development emphasize increases in the productive and consumptive capacities of societies. An increase in society's ability to extract resources and manufacture them into consumptive goods is considered development, as is increasing complexity in the service sector of society, which is instrumental in distributing labour. Furthermore, growth in the trade of goods and services is typically defined as development. Economic development typically has a positive connotation, as most people associate development with an increase in living standards. Among many environmental social scientists, however, economic development is often associated with negative ecological impacts.

Social Adaptability

Early liberal and functionalist theoretical approaches discussed how economic and social structures affect society's ability to adapt to various types of change. For the purposes of the model presented in this paper, social adaptability refers to *the extent to which a society's institutions are prepared to deal with challenges and changes brought about by natural resource scarcity*. E. Durkheim considered the division of labour as key to social adaptability. T. F. Homer-Dixon (1995) discusses social adaptability in terms of society's ability to supply enough ideas and ingenuity to solve its social and technical problems. While stable political, economic, family,

and legal institutions all increase social adaptability, a strong educational system is often considered key to a society's ability to develop new knowledge and strategies for adapting to social and ecological change.

Social Breakdown

Social breakdown can imply many things. In the theoretical model presented here, it refers to *the negative social consequences, which may be associated with natural resource scarcity*. These consequences include human migration and expulsion, receptivity to insurgency, decreased economic productivity, and a weakened state. When resources are scarce, large numbers of people are often compelled to migrate in search of more favourable living conditions. In some places there is not enough arable land for farmers to work so they must move elsewhere. In many cases the effort to increase freshwater supplies by building dams displaces people who formerly lived in the flooded river valley. Often, the reason for the need to migrate uniquely affects a certain ethnic or social class group who must then migrate into unfamiliar or hostile territory. Furthermore, as resources become scarcer, agricultural and economic productivity may decline, leading to reduced profitability of investments. Declining productivity may foster insurgency, as people blame their government and offer alternative political agendas for the solution to scarcity problems. All of this weakens governments, which opens opportunities for civil violence and other types of conflict.

A Conceptual Model of Natural Resource Conflicts

Building from an analysis of the theories and concepts presented above, I have developed a theoretical model, described in detail below, which can be applied to predict the likelihood of conflict or cooperation between societies or elements of societies over scarce natural resources. Figure One depicts the conceptual model graphically and shows the expected relationships, based on the social science theories discussed above, between these predictor factors and natural resource conflict.

There are three driving factors in the model. These are demographic change, economic development, and social inequality. Demographic change is expected to have indirect effects on natural resource conflict by affecting economic development, natural resource scarcity, and social inequality. Economic development is predicted to have a direct positive effect on population growth and urbanization, as well as a negative effect on natural resource conflict directly and indirectly through social adaptability. Social inequality is predicted to have a positive direct effect and a positive indirect effect through natural resource scarcity on natural resource conflict.

The mediating factors in the model are natural resource scarcity, social adaptability, and social breakdown. Natural resource scarcity is predicted to have direct and indirect effects, through its impact on social breakdown and potential negative effects on social adaptability, on natural resource conflict. Social adaptability may decrease the likelihood of conflict over natural resources, as more adaptable societies will take steps to ameliorate the sources of dispute. Furthermore, social adaptability may reduce natural resource scarcity as innovations and technology alter the use or definition of the resource base. Additionally, social adaptability may reduce social breakdown by generating alternative strategies and approaches for dealing with problems. Finally, social breakdown may cause natural resource conflict directly or indirectly by causing social and ethnic inequalities. For example, human migration may directly create competition between groups over resources, or may indirectly contribute to social inequality that accompanies migration of relatively poor groups into more resource rich areas.

The utility of this model may be assessed by applying it to the topic of international freshwater conflict, a problem that has been predicted to become more common and more frequent in the coming decades.

International Freshwater Conflicts

A large body of literature in political science, geography, and development studies has discussed cases of current and potentially ongoing international freshwater conflicts (see for example: Donahue, J. M. – Johnston, B. R. 1998; Gleick, P. H., 1993; Haftendorn, H., 2000; Postel, S., 1996; Samson, P. – Charrier, B., 1997; Scheuman, W. – Schiffler, M., 1998). Because water is a valuable resource, which frequently crosses political borders, the right to exploit water resources has often come into dispute. The literature on this subject has extensively speculated on the causes of international water disputes. In this section I will describe the findings of research that illustrates and supports the propositions shown in Figure One above and discuss how they relate to water conflict.

Factors Which May Cause Water Conflicts

Demographic Change and Water Conflicts

Population growth is a potential cause of conflict over water, particularly through its effects on water scarcity (Gardner-Outlaw, T. – Engelman, R., 1997). While many of the great sources of fresh water are already overextended, current population growth in certain regions of the world, particularly arid regions, will make the problem worse in the near future. Biswas *et al.* conclude, in reference to the Middle East region, that when all is said and done, when all the water projects are in place and all the available water delivered and recycled and conserved, when agriculture has completely given way to domestic use, a critical shortage of water for human consumption will persist unless population growth stabilizes. (Biswas, A. K., et al., 1997, p. 38)[2]

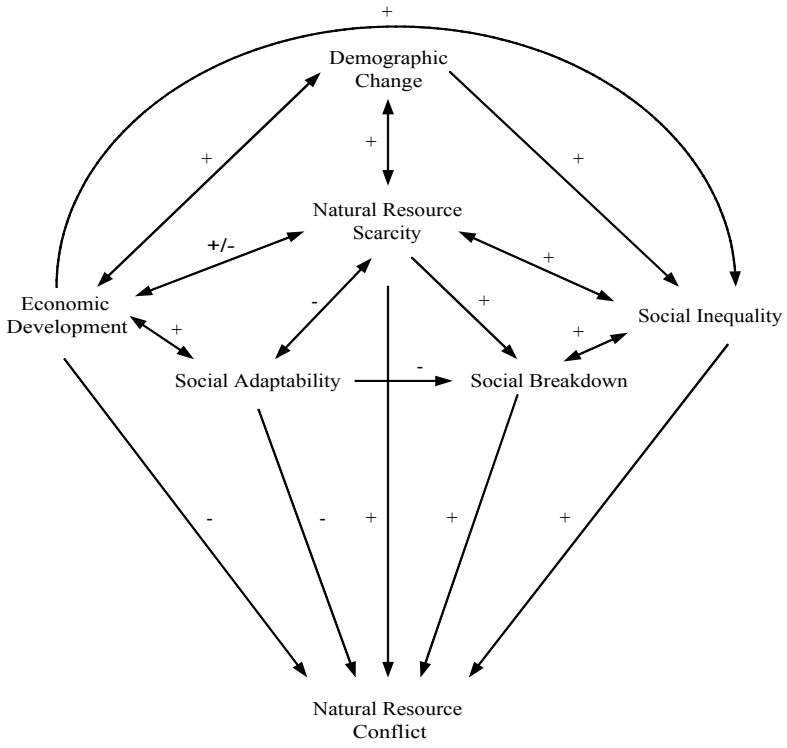

Figure 1. Conceptual Model of the Relationships Between Factors Which May Cause Natural Resource Conflict.

Biswas *et al.* discuss this problem in light of the fact that populations in the Middle East region have been steadily growing and are projected to continue growing. While water has been a key issue in the development of the Middle East for centuries (Saliba, S. N., 1968; Stevens, G. G., 1965), projections for population growth in this area show that most Middle Eastern countries can expect their populations to double in the next 25 years. Postel estimates that by 2020, over 1.3 billion people in Africa and the Middle East alone will live in countries that do not have enough internal water sources to supply each person with a healthy supply of potable water (Postel, S., 1996).

In addition to simple population growth, another factor that will make water sharing more problematic is the international trend of an increase in the percentage of people living in urban areas (Biswas, A. K., et al., 1997). It is much more difficult to supply quality water to urban residents than to rural residents, and it is also more difficult to treat the vast amounts of sewage coming from cities than it is to treat the much smaller quantities created in rural settings. Water problems associated with urban population growth are occurring particularly in Southeast Asia, South Asia, Southwestern North America, and Sub-Saharan Africa. It is predicted that population growth and urbanization will cause conflict over water by increasing water depletion and degradation.

Water Scarcity and Water Conflicts

[2] It must be noted here that Biswas et al. are merely making a *hypothetical* statement to the effect that if all industrial and agricultural water interests were denied, such that fresh water was reserved for the exclusive purpose of human consumption, there could still be a water shortage in the Middle East. In *reality*, however, in many places, most notably the American West, agricultural interests have water rights as property in the same sense as mineral rights and estate rights.

Water resources throughout the world, both surface and underground sources, have been over-utilized and polluted. One of the primary reasons that water resources have been overextended is the dramatic increase in irrigation agriculture that took place in the twentieth century. Many countries that cannot rely on rainfall for their crop production use large shares of their surface and underground water resources for irrigation. But the amount of worldwide irrigated land shows evidence of the depletion of many water sources. Postel (1996) points out that the world total irrigated land area increased dramatically between 1960 and 1980, but has declined since 1980 to pre-1960 levels. Another indication of the depletion of water resources is the over-pumping of underground aquifers. Many large aquifers that supply water to produce crops supporting much of the world's food needs are being pumped faster than the natural rate of replenishment. One very visible sign of water over-utilization is the growing number of major rivers that do not reach their delta at all or at least during some part of the year. This has been a problem with the Colorado River, the Ganges River, the Yellow River, and the Amu and Syr Dar'ya Rivers, among others (Abramowitz, J. N., 1996; Assaf, K. *et al.* 1993; Begum, K., 1988; Crow, B. – Lindquist, A. – Wilson, D., 1995; Ingram, H. – Laney, N. K. – Gillian, D. M., 1995; Lewis, D. R., 1995; Postel, S., 1996).

In addition to the overuse of water resources, there has been extreme pollution and other types of degradation occurring in most major water systems worldwide. One of the best indicators of the degradation of water systems is the state of the various species of fish and other aquatic life native to the water systems in question. In many of the world's traditional fish stocks we have seen mass extinction of native species of fish and threatened statuses for many other species (Abramowitz, J. N., 1996). The main factors that contribute to the degradation of the world's major water systems are the destruction of the surrounding watersheds, deforestation, mining, agricultural runoff, damming, sewage discharge, chemical discharge and oil spills, soil erosion, and channelling for transportation. Currently, the overall water quality and the ability of most of the world's major water systems to support indigenous aquatic species are declining. As water depletion and degradation increase, competition over water is likely to increase. This could contribute to conflict over water directly and indirectly by causing social inequality and by decreasing social adaptability.

Social Inequality and Water Conflict

Inequitable distribution of water in places where water is scarce may also increase the likelihood of conflict. Since rivers and aquifers do not respect international borders, it is often the case that countries receive much of their water from a river source that does not originate within their own borders. It is also often the case that countries with headwater sources and large amounts of rainfall retain the water through the use of dams and irrigation and deprive downstream countries of water they have traditionally depended on. Postel (1996) reported that 19 countries, mostly in Africa, the Middle East and the dry parts of central Asia, receive more than 20 percent of their water from outside their own borders. Seven of these countries receive more than 90 percent of their water from sources outside their own borders (Turkmenistan – 98%, Egypt – 97%, Hungary – 95%, Mauritania – 95%, Botswana – 94%, Bulgaria – 91%, Uzbekistan – 91%)[3]

These types of water sharing relationships are potentially incendiary because attempts by either the headwater states or the downstream states to alter usage patterns can quickly lead to confrontation (Durth, R., 1998). Evidence of this possibility can be seen in a small confrontation between Egypt and Ethiopia in the 1970's. Egypt had begun plans for sharing some of the Nile waters with those living in the Sinai peninsula and possibly Palestine. Ethiopia responded that this would be a misuse of the Egyptian share of the Nile waters. Anwar Sadat replied that "any state that tampered with Egypt's water supply would risk a military response (Biswas, A. K. et al., 1997, p. 25)." As this example illustrates, it will be important to consider issues related to inequitable distribution of water resources in understanding potential causes of conflict and dispute over water.

Another set of issues that may play important roles in the future of disputes over internationally shared resources is social inequality and ethnic diversity within water sharing regions. With respect to ethnic diversity, it is likely that we will see more cooperation in areas that have similar ethnic composition, and more competition in areas with dramatically different ethnicity. It becomes even more difficult to resolve politically charged issues, such as water allocation, that have to do with the very survival of some countries when the parties involved in negotiation have moral and philosophical ideologies that are antithetical[4].

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[3] This statement should not be misconstrued to mean that countries, such as Egypt, have to cross their borders to find water. Of course the water Egypt uses is from the Nile River, which flows across the length of Egypt. Nevertheless, the water in the Nile does not *originate* in Egypt in the form of rain or other streams: the water in the Nile in Egypt is flowing down from Ethiopia, Sudan, Uganda and other countries.

[4] The speculation that ethnic diversity could contribute to conflict should not be read to mean that diversity is "bad" for society. At the social and cultural level, many believe that diversity broadens people's horizons and contributes to sharing of ideas, melding of values, and so forth. At the political level, however, ethnic diversity can often complicate the process of

Two examples illustrate the importance of culture and ethnicity in water conflict. In northeastern Arizona there has developed a legal dispute between the Hopi Indian nation, the state of Arizona, and various multinational mining interests (Whiteley, P. – Masayesva, V., 1998). The Hopi believe that their entire culture is integrally related to and dependent on the various springs that provide water for their drinking, cooking, livestock and crops. The state and the mining interests have been over-pumping the aquifer that feeds the Hopi springs. While the outside political interests claim that the springs can be recharged, the Hopi claim that the mining company's use of their spring water for transporting coal slurry is both illegal and immoral based on the Hopi world view which sees the waters as sacred.

Another example of ethnicity affecting water conflict is in the Jordan River area. Much of the conflict in this region stems from the deeply divisive religious and philosophical differences between the Arabs and the Israelis (Hassoun, R., 1998; Renger, J., 1998). For this reason, it is difficult to distinguish between conflict over natural resources and conflict more generally in this region. Nevertheless, researchers agree that ethnicity is an important factor contributing to conflict over water in this river basin.

Social inequality within and between countries may also contribute to water conflict. Inequality *between* countries may influence conflict in various ways, potentially as a result of relative deprivation issues, such as one state claiming that it has not received the benefits of development, which are associated with adequate water supply. Social inequality *within* countries can also contribute to inter-state conflict by creating volatile confrontations which could easily spill across borders. Extreme social inequality within states could, in various ways, ratchet up the possibility of both internal and external conflicts over water.

Economic Development and Water Conflict

Industrial-capitalist norms which support large-scale endeavours such as massive dams, diversion projects, and land reclamation may harm the balance of ecosystems, making it difficult for subsistence farmers and peasants to make a living. In a sociological/ecological analysis of the development of water scarcity in Sri Lanka, Starkloff finds that human conduct in ecological systems is dependent on economic and social systems (Starkloff, R., 1998). Traditional norms for water use supported agricultural and resource extraction technologies that maintained the integrity of the hydrological cycle, however development brought a paradigm shift which supported maximization of water extraction for agriculture and created an asymmetric power scenario in which lower class agrarian communities were marginalized. In this case, changing human land use patterns due to economic development directly caused the degradation of the water cycle, leading to competition for water.

In many places where corporate and wealthy interests have taken precedence over the sustainability of local populations the potential for conflict has increased (Samson, P. – Charrier, B., 1997). Further, when one nation's development occurs at the expense of another–as in the case of large scale dam and water diversion projects on international rivers–conflict between the countries is one potential outcome and has already occurred on the Nile, Tigris and Euphrates, Jordan, and Colorado rivers, among others (Ingram, H. – Laney, N. K. – Gillian, D. M., 1995; Scheumann, W. – Schiffler, M., 1998; Sosland, J. K., 1998; Wolf, A., 1995).

Trade between nations is a factor, which will affect the likelihood of countries cooperating on contentious political matters such as water. Empirical results of studies on trade and conflict have found mixed support for the notion that trade reduces conflict. Oneal, Oneal, Maoz, and Russett (1996) found that high amounts of exchange between countries lessen the chances of conflict between those countries. Barbieri, however, found a curvilinear relationship between trade and conflict: "low to moderate degrees of interdependence reduce the likelihood of dyadic disputes, and extensive economic linkages increase the probability of militarised disputes. Extreme interdependence ... has the greatest potential for increasing the likelihood of conflict" (Barbieri, K., 1996, p. 29). When it comes to conflict over freshwater, it is unclear whether trade between nations contributes to or inhibits conflict.

Social Adaptability and Water Conflict

The theoretical model depicted in Figure One predicts that social adaptability will decrease the likelihood of conflict over natural resources. This prediction holds true for international conflict over water. Countries that have the lowest amounts of human capital and the weakest institutional frameworks have been the hardest hit by water scarcity, while those countries with strong institutions and infrastructure have generally avoided serious conflicts over water (Appelgren, B. – Klohn, W., 1999). There is a lot of room for technological innovations regarding water supply and distribution. The existence of strong educational and research institutions in societies will strengthen their ability to adapt to natural resource changes. Such adaptations should reduce the likelihood of

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negotiating decisions and therefore become a source of conflict.

conflict over water. Examples of adaptations that have occurred or could occur are the use of dams to control and regulate water flows, technologies to clean polluted waters, increases in efficient water use and distribution, and the desalinisation of seawater[5].

Theoretically, such adaptations should reduce water scarcity as well as decrease the likelihood of conflict directly. One problem associated with certain adaptations, however, may be the displacement of large numbers of people. For example, the construction of dams to regulate and control water flow has displaced millions of people worldwide in the twentieth century.

Social Breakdown and Water Conflict

Water related issues might cause human migration in several ways. In addition to the displacement of people caused by the construction of large dams, migration may also be caused by water shortages, floods, water pollution, and inequitable distribution of water. When large numbers of people are forced to relocate due to water issues they may come into conflict with the established residents of their new location. Such conflict may be caused directly as immigrants become competitors for existing resources or indirectly due to the social and ethnic inequalities, which arise when immigrants relocate in more abundant regions.

A notable example of problems associated with migration caused by water is the Ganges River basin in South Asia. Bangladesh, a low-lying country on the Ganges River delta, suffers alternately from water shortages and floods. During the dry season much of the Ganges water is siphoned off upstream for irrigation and other projects. During the wet season the Ganges floods the delta creating standing water on much of the Bangladeshi flood plain. Environmentalists claim that the excessive flooding in Bangladesh is caused in part by deforestation upstream in India and Nepal. Due to water shortages, floods, and pollution, many Muslim Bangladeshis have migrated into predominately Hindu India. This has contributed to ethnic strife in border regions (Crow, B. – Lindquist, A. – Wilson, D., 1995; Crow, B. – Sultana, F., 2000; Swain, A., 1996). While the Indian and Bangladeshi governments have formally committed to plans that should ameliorate some of the water problems, citizens of each country are still subject to the consequences of years of irresponsible water management.

Gabčíkovo

The particular case of the dispute between Slovakia and Hungary over the development of the Gabčíkovo and Nagymaros dam project can provide further explication of the utility of the model of resource conflict proposed in Figure One. In the period before and after the Hungarian–Czechoslovak treaty that initiated the joint dam project along the Danube on the common border, cooperation on environmental issues among Eastern European communist countries was enforced by the Soviets. According to Murphy, "Soviet domination kept potential political, economic, and ethnic conflicts among the east European Danube countries under control. Allegiance to Moscow by most, if not all, of the country leaders, to the Warsaw Treaty Organization, and to economic ties ... contributed to regional cooperation" (Murphy, I. L., 1997, p. 64). But the inattention of the communist regimes to control environmental degradation and depletion contributed to the rise of environmental social movement organizations, which ultimately helped bring down the old governments.

The case of Gabčíkovo-Nagymaros illustrates how industrial and technological development by communist regimes lead to water scarcity and degradation. The navigation canal and the hydroelectricity plant on the Danube along the Hungarian–Slovak border siphoned water away from the natural bed of the river, lowering water tables and drying up side channels of the river. Protest in Hungary about the environmental effects of the dam lead to social breakdown in Hungary in the form of a weakened state. Protesters seized the opportunity to support environmental policy, which was in conflict with the agenda of the Slovak government. The political opportunities associated with democratic reforms in Hungary caused previously existing discontent to come out. So, with the fall of communism, disagreement between environmentalists and developers, and between Hungarians and Slovaks could be fought in an open forum. Historical ethnic disputes between the two countries exacerbated the problem. Ultimately, third party intervention by the European Community and the International Court of Justice helped bring about a greater degree of cooperation.

[5] While technological innovations such as those mentioned could very well reduce water scarcity, they are not without environmental drawbacks. For example, desalinization of seawater could alter the chemical balance of coastal regions where the water is withdrawn. Damming of rivers has many negative ecological consequences, which affect not only aquatic and animal species, but also humans. The adaptations mentioned here are considered positive to the extent that they may alleviate water scarcity for humans or prevent conflicts.

Many of the environmental and social activists in Hungary who protested the development of the Danube have since been elected or appointed into positions in the Hungarian government. In their new positions, these former activists have been pursuing institutionalised avenues of negotiating with the Slovak diplomats. Because of this, relations between Hungary and Slovakia have normalized, although the tensions are not entirely resolved. In the final picture, we see the following pattern. Under the centralized rule of Soviet backed communism prior to 1990, conflict over water and other natural resources was minimal or non–existent between the East European states. As a result of the opening up of the political systems, and ultimately the fall of communism, in these states, the voices of discontent grew louder and this was followed by formal dispute over water policy between Slovakia and Hungary. Once the new political and economic reforms became entrenched, and previous activists became members of the official state structure, conflict declined as institutionalised procedures were pursued.

Relating this case specifically to the model presented in Figure One, we may summarize the Gabčíkovo-Nagymaros case in the following way. The desire for economic development in the Danube basin led to the plans to dam the Danube for navigation and power generation. The construction of the dam itself contributed to the degradation of the river and its channels, at least temporarily, during the construction phase. The nature of communism in Central Europe prior to the democratic revolutions created a social system that was not so adaptable to changing political and ecological conditions. The degradation of the river caused protests and various other forms of social breakdown. Furthermore, the break-up of Czechoslovakia into two countries contributed to the conflict, as Hungarians used the argument that they did not sign a treaty with Slovakia and so therefore they weren't obliged to uphold the original treaty. The entire situation was made worse by the ethnic tensions between Slovaks and Hungarians. All of the factors depicted in Figure One played a role in the conflict between Slovakia and Hungary regarding the Gabčíkovo-Nagymaros dam.

Conclusions

There has been some disagreement on whether and to what extent the environment and political security should be linked together. Some have argued that the linking of the environment with security issues has "militaris(ed) our thinking about the relationship between humanity and the environment" (Græger, N., 1996, p. 111). However, according to Græger, others have argued that including the environment in security issues has demilitarised security thinking. In this paper I have discussed several social, economic, and ecological factors, which may affect natural resource conflicts or environmental security. Using the case of international conflict over freshwater, I have given some support for the conceptual model presented in Figure One above. Real testing of the model would involve addressing multiple complex methodological issues, however research already done using a large quantified set of data on international water disputes reveals some support for the connection hypothesized in the figure (Green, B. E., 2002).

There are some obvious limitations to the model developed in this paper. I have greatly simplified the theoretical perspectives and conceptualisations from which I draw propositions that apply to natural resource conflict. These simplifications were made in an attempt to integrate a number of different perspectives, which at first glance may appear to be only peripherally related. A more detailed discussion of each theoretical perspective would likely only cloud and confuse the general model, as opposed to making it more parsimonious. This model is intended to be a starting point for further exploration and development. Natural resource conflict is a topic, which has received relatively little attention by sociologists; theory and empirical research on the topic is at best weakly developed.

In addition to simplification of theoretical perspectives used in my model, I have simplified the conceptualisations of factors predicted to affect natural resource conflict. For example, the concepts of social adaptability, social inequality and social breakdown are tremendously more complex than I have depicted them herein. Nevertheless, I have attempted to bring these terms into a theoretical discourse, which will enrich the discussion of macro-level factors contributing to conflict over natural resources. In general, I have adopted conceptualisations, which others have developed in previous discussions. Future empirical research will have to grapple with more detailed definitions and operationalisations of the complex factors applied in this paper.

The main goal of this paper was to organize a diverse set of social scientific theories into a comprehensive theoretical model, which can be applied to the study of conflicts over natural resources. The need for such theoretical integration is increasingly important as more and more people are facing extreme natural resource scarcity. Water scarcity is a pressing social concern in many areas around the world and many speculate that it will be an increasing source of conflict in coming decades. In this paper I have attempted to provide the theoretical integration needed to help organize social scientific inquiry into natural resource conflict.

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