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The Issue of Biodiversity in Palestine

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Introduction :

Few recognize how critical the work of the coming years will be in determining the future of the gene stock and genetic integrity of the plant life and agriculture in Palestine. Palestine (defined here as West Bank and Gaza) lies in the heart of the fertile crescent, the cradle of Western civilization, and as such is the place where globally consumed crops such as wheat and barley were first domesticated (14). It is a land in which, though small in size, there is tremendous diversity of climates and ecosystems. Yet after centuries of environmental mismanagement and 27 years of an occupation that has systematically denied Palestinians the rights of access to or development of the land, it is also an area in need of environmental rehabilitation. While clearly not an issue that will make news headlines, biodiversity and genetic conservation are among the most urgent of the issues that needs addressing.

From our point of view this issue must be approached from a number of contexts: the irrigated agriculture; dry land agriculture; pasturelands; and open areas. In all of these areas there is increasingly reason for concern about the future of biodiversity. The range of genes used in irrigated crops is frighteningly small, as was evidenced in the past year when, in part because of bad seeds from one variety of tomato, there was a major shortage throughout the country, which even months later is still effecting the market price. The area devoted to rainfed farming has decreased significantly since the Israeli occupation in 1967. Likewise, the funding for agricultural research has plummeted and access to non-Israeli seed has been almost non-existent. Tremendous potential biodiversity exists in pasture land, particularly in the Eastern Slopes region. However, military closures on most of the area has forced shepherds to graze their animals on far too little land, causing severe overgrazing, and has kept researchers from studying the majority of the area. Lastly, with high population and a small area in which to settle, expansion of Palestinian population centers risks destroying the very land most valuable for natural resources or agriculture.



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All of these problems will be outlined below and efforts will be made to describe the programs needed to reverse this dangerous trend.

The Land of Palestine and its People :

Palestine, as it stands now, is divided into two distinct regions covering a total area of approximately 6,065 km² (6 million dunums). The larger of these two areas is called the West Bank (covering 5,700 km²), with the Gaza Strip covering only 365 km² . (Map 1)

The West Bank is administratively divided into 7 regions: Hebron, Jerusalem, Ramallah, Jordan Valley, Nablus, Tulkarem, Jenin. There are only four major urban centers, Jerusalem, Nablus, Hebron and Gaza, with 440 villages and 27 refugee camps. However, these administrative boundaries do not follow ecological and climatic regions in the area. There are four of these: (Map 2)

The Jordan Valley region, a low lying area (up to 250 m below sea level) of low rainfall (100-300 mm annually) which runs along the Jordan River from northern Hebron, with altitude ranging from 400-1000 m above sea level, and averaging relatively high rainfall (400-600 mm); the Eastern Slopes, the hills just above the Jordan Valley, with altitude ranging from 200 m below sea level to 600 m above, receiving moderate rainfall (250-400 mm) and stretching across all of the districts except for Tulkarem, from Jenin in the north through Hebron in the south; the Central Highlands run across the center of the area crossing from Jenin to northern Hebron, with altitude ranging from 400-1000 m above sea level, and averaging relatively high rainfall (400-600 mm); though small in size (312 km² west to east and 60 km north to south), the SemiCoastal region is the fertile, low lying (100-300 m above sea level), part of the West Bank, located in Tulkarem and Jenin and receiving relatively high rainfall (500-600 mm) (3). (Map 3)

The Gaza Strip is an area of 365 km² located next to the Mediterranean sea, on the edge of the Sinai desert and ranging in altitude from sea level to 100 m above. Rainfall in the region ranges from 400 mm annually in the north to 230 mm annually in the south (3). While it was chiefly rural before the creation of the State of Israel, the influx of refugees in 1948 has led to a population of almost one million making it one of the most populous places on earth (12). (Map 4)

Factors Contributing to Biodiversity :

Palestine's proud history as the cradle of civilization and a focal point of the world's three monotheistic religions has long given it a global influence belying its size. It is a tiny piece of land whose compactly coexisting religious, ethnic and political diversity is echoed in the remarkable range of ecological variation found within its close borders. Admittedly, world attention in recent years has had far more to do with the politically conflicting claims to the land than to the rich ecological diversity to be found thereon (7).



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In this sense, Palestine's geographical position has been both its blessing and its curse. Located at the terrestrial meeting point between Eurasia and Africa, it was in the land of Palestine that the plants and animals of three continents interacted and spread. This contributed to the uniquely rich diversity of Palestinian flora and fauna which has long captured the interests of ecologists and scientists. This diversity is nurtured also by the abruptness with which climatic zones desert, steppe, Mediterranean woodland, and even oasis adjoin one another in this compact geographical area. There are places where, because of topographical peculiarities, the buffer zone between desert and woodland is so narrow that it is virtually indistinguishable. From an elevated vantage point in Jerusalem, for example, one observes woodland and Mediterranean vegetation to the west and stark desert to the east, with the typically transitional steppe land scarcely discernible on the mountain ridge dividing the two zones. Despite its small size, Palestine is host to over 2,500 species of wild plants with new ones discovered each year. Approximately 800 of these plants are considered rare, and around 140 are endemic. In comparison, Great Britain, although far larger, is home to only about 1,750 plant species. At least 80 species of wild mammals are found in Palestine, and its reputation as a geographical and ecological crossroads is reinforced by the fact that 380 different species of birds can be identified there. This number, within such a small area, again becomes significant when compared with countries such as Britain, France or Spain in which only 400 to 440 species can be found despite their far greater size (2).

Even Palestine's global position as a historical and religious focal point an intellectual crossroads, if you will has contributed the diversity of its flora and fauna. Citrus fruit, so important to Palestinian and Israeli agriculture, was brought here from Portugal, from where the Arabic name for oranges ("bortugal") is derived. The sabra cactus, adopted by both Palestinians and Israelis as an important symbol, arrived here from North America only 200 years ago. The extent to which geographical Palestine has attracted the combined attentions, and often fervent intentions, of world civilization has been a source even of its ecological richness (7).

Unfortunately, this legacy of intense human interest has had serious consequences for the environment. Throughout its history, Palestine has faced its share of important, if relatively normal, environmental menaces disease, locust plagues, and climatic severity. Changes in climatic patterns, so crucial in reshaping ecology, should not be weighed too heavily as there is no conclusive evidence that climatic conditions in Palestine have changed significantly throughout recorded history. It is true that Palestine is currently experiencing a dry spell spanning several years, and it is also true that we exist under the ominous specter of the greenhouse effect and global warming, with possible dramatic impacts upon the intertwined meteorological and ecological balances of every region of the globe, including Palestine. But weather patterns, typically cyclical over extended periods, must be evaluated within a longer time frame to be of any real use, and this can only be done retrospectively. There is, however, botanicalarchaeological evidence indicating, on the basis of changes in the distribution patterns of various woody plant



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species, that over the past 5,000 years the climate of Palestine has become gradually drier and warmer (15). It is highly probable, according to Waisel, that centuries of human activity, particularly the denuding of vast areas by overgrazing and timber overuse, have contributed to and intensified this process of desertification. As population pressures mount, such trends may well continue or even become worse. To this must be added the unknown factor of global warming which, theoretically, could eventually further accelerate warming trends. More immediately accessible to objective verification are the changes which have occurred in the physical Palestinian environment. These are changes which have occurred due to an array of factors, but more than any other, due to human presence and activity. These next pages will give a summary overview of some of the major negative impacts of humanity upon the fertile but fragile Palestinian environment.

The Land As it Was :

If one of our forbearers were to return, he or she may have difficulty recognizing this as the same land described by early visitors as a land "flowing with milk and honey". Barren hills have taken the place of what was once rolling woodland covered with thickets and forests. Deserts have replaced grassland. The winding Auja now swims with refuse and is laced with chemical wastes. The Hula Lake and its surrounding marshes have been drained. Only a winter of recordsetting rains has brought the Lake Tiberias back from dangerously low levels, just centimeters above the environmental "red line". A fetid trickle of sewage now runs where once was the Jordan River. And the Dead Sea has sunk so low that it is now two separate seas and still dropping. Gone from the land are animals which were once plentiful the ostrich, cheetah, leopard, lion (the last ones killed 800 years ago during the Crusades), Syrian bear, crocodiles and several kinds of deer casualties, each of them, to human encroachment (7).

The first people to arrive in ancient geographical Palestine were hunter/gatherers. Their habits and numbers were such that they interfered little with their host ecosystem. But once they began settling and farming the fertile valleys and hillsides they encroached quite radically upon the ecological status quo. Cultivated crops replaced native vegetation as vines and orchards replaced native forest and shrub land and were maintained with terracing and manmade irrigation channels and drainage ditches. All was fine as long as this network of human alteration of the native plant and landscape received the attentive human maintenance it required. Unfortunately, such continuity was prevented by the succession of wars brought to the area by subsequent waves of conquerors who killed or drove out the farmers. Human "improvements" and cultivated vegetation were left abandoned and fell into ruin, leaving the soil, now deprived of even its native cover, subject to extensive erosion. This was especially true at the higher elevations where the scantiness of the soil, combined with the erratic rainfall of the region, made it difficult for the original vegetation to reassert itself. Successive cycles of cultivation and neglect characterize the history of Palestine's arable land down through the centuries, as one



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invader followed another, bringing wars, often in close succession, which violated the countryside and left the landscape drastically and permanently changed (7).

Despite the legacy of adversity, the stubborn fertility of the land of geographic Palestine made it one of the most productive of Syrian provinces prior to the arrival of the Crusaders. Frequent Crusader references depict a land spread with olive groves, orchards, vineyards, and watered gardens, hills covered with brushwood, and fields planted in corn, barley, oats, sorghum, lentils, sesame, millet, beans, flax, and indigo. And long after the departure of the Crusaders and the arrival of the Turks, the abundance of the Palestinian landscape and agriculture drew the admiring notice of such visitors to early nineteenth century Palestine as the French traveller, Volney, and the Englishman, Sir Moses Montefiore (8). So, while we must be sobered by the consistent threat which the presence and activities of man have brought to the environment and to the delicate balance of natural ecosystems, we must also be alert to the hope and responsive to the opportunity afforded by the tenacious resilience and adaptability of the natural world.

Changes in the Green Cover :

Human infringement upon the composition of Palestine's native vegetative cover has occurred primarily in four ways: gathering of wood for fuel and lumber, overgrazing by domesticated sheep and goats, conversion of woodlands to arable land, and forest fires, both planned and accidental (17). Old Testament references indicate that the cutting of forests in Palestine began centuries ago, a practice which has continued ever since with varying degrees of intensity. Canaanites, Hebrews, Romans, Byzantines, Arabs, Crusaders, Mamluks, Turks and Zionists have all played their role. Charcoal production and commercial lime kilns consumed many trees (17). Even within the past several years, thousands of hectares of forests have been lost to forest fires. And the intensity of air pollution in the north, especially near Haifa, is killing thousands of trees in the Carmel hills.

During the Turkish occupation of Palestine, vast areas of remaining natural forest were lost as large numbers of trees and shrubs were cut to provide fuel for Turkish railways. Many naturally occurring forests across Palestine disappeared and the consequent reshuffling of the vegetal composition led to the loss or marginalization of large numbers of native flora (7).

Under Israeli occupation, new sets of rules affecting the environment and natural resources were imposed to serve the objectives of the occupier. Afforestation was forbidden throughout most of the occupied territories and water use was limited through the closure or confiscation of irrigation wells and through strict drilling restrictions. Partially because rainfall was so minimal, particularly in the eastern parts of the West Bank, many Palestinian farmers were forced to leave their land and join the labor market



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in Israel. Sizeable areas of land were neglected and returned to semidesert in yet another chapter in the long legacy of environmentally disruptive displacement (7).

Population :

The Palestinian population now stands at about 2.4 million, about 900,000 of whom live in Gaza. While no census has been done since the beginning of Israeli occupation in 1967, estimates are that approximately 27 percent of the West Bank Palestinian population lives in urban centers, 17 percent live in refugee camps and the remaining 56 percent live in rural areas (10, 11). The population in Gaza is much more urban, averaging 2,466 persons per km² in the Strip (3,161 per km² if it is remembered that 22 percent of the land is controlled by Israeli settlers), with the large majority of the population living in either in cities or refugee camps (10,12).

Palestine averages a very high population growth rate, higher than the Middle East regional average, but lower than the Israeli growth rate if immigration is included (6). This will undoubtedly impact the urgency with which the issues of biodiversity and plant genetic conservation must be addressed.

Of particular concern is the growth of population centers in Palestine. Already, Israeli planning commissions have predicted that Israel by early in the next century will have little natural or agricultural space. Likewise, ARIJ overlays of soil and Palestinian built up areas show that housing and industrial areas in the West Bank are exactly on the soil that is most suitable for agricultural development. As municipal waste and sewage are already inadequately disposed of at the current population, major expansion in that population could have detrimental effects on the environment and ecosystem if planning and zoning do not happen immediately. (Map)

Occupation :

The continuing Israeli occupation is a serious hinderance to biodiversity and genetic conservation efforts. More than 22 percent of Gaza remains occupied by Israeli settlements and their security zones, which happen to sit on the best sweet water sources in the Strip, and the borders of Jericho were drawn in such a way as to avoid Israeli settlements (1). In the other 94 percent of Palestine, 125 settlements, occupying 250 separate locations, exist in the West Bank and are continuing to expand. Even when the settlements themselves are not expanding, roads, infrastructure and security areas take up valuable land from Palestinians. Declared nature reserves have occasionally been used to establish new settlements. Forty percent of the West Bank, 85 percent of the Eastern Slopes, continues to be a closed military zone, isolating it both from bedouin shepherds and Palestinian scientists who would like to study the plant and animal life within the closed off area. In all, 60 and 70 percent of the land in the West Bank remains occupied (6). (map)



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Other Israeli actions have further led to the destruction of Palestinian land. Constraints have been placed on Palestinian agriculture, restricting movement through curfews, bans on entering or passing through Jerusalem, thus preventing farmers from reaching their fields or transporting produce to market. Since the Intifada, Israel has also canceled export permits during peak production periods as a form of collective punishment, thus encouraging farmers to discontinue farming. Over 250,000 trees have been uprooted in the last seven years, and afforestation is prohibited. Farmers often plant olive or stone fruit trees in places more suitable for field crops because following practices associated with the latter predispose the area to confiscation. Restrictions are also in place preventing the establishment of a Palestinian body to oversee land use and development planning (4). In the long run, a permanent resolution to this problem will be necessary for there to be a program that truly addresses the issues of plant genetic diversity in this land.

Economy :

Palestine remains economically non-industrialized, with one third and the base of the economic GDP made up from agriculture, little industrial development because of Israeli restrictions, a large service sector and a large amount of Palestine's monetary resources coming in from laborers working in Israel. The per capita GDP of between US\$610 and US\$2,400 annually means that Palestinians must worry about sustainable development, not just nature conservation (especially when living next to Israel, which has a per capita GDP of between US\$10,000 and US\$15,000 per year) (13,16). The rationalization for the conservation of plant genetic resources will need to be made in clear, economic terms.

Palestinian Society :

While with the displacement resulting from the Israeli invasions of 1948 and 1967, Palestinians have become increasingly detached from the land, Palestinian society is traditionally very close to the land. It is, after all, land on which they have existed for millennia. There is not only a relationship with the history of this land, but an organic relationship with the natural surroundings. It is exactly this attachment that should be used in education programs about biodiversity and genetic conservation.

But it is also a land that is changing as a result of a large population, occupation, unmanaged development and other factors, all of which are surfacing in the form of soil erosion and desertification. The indigenous population that is wholly dependent on the land, specifically the Bedouins, are being forced to change as well, in part from the political situation, but also from the decreased amount of land suitable for grazing. With the increasing displacement and marginalization of this population, there is the risk that the indigenous knowledge about plant life and animals and their uses in the Eastern Slopes could well be lost. It is important that this population be integrated into plans to study biodiversity in this area, and helped to understand their interest in the long term sustainable management of Palestine's rangeland.



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Agriculture :

Agriculture is of vital importance in Palestine, accounting for about 30 percent of both Gross Domestic Product (GDP) and employment, with about 50 percent of Palestinian people benefitting directly from agricultural returns (16). It is characterized by both intensive irrigated agriculture, in the Jordan Valley and Gaza Strip, and partially in Tulkarem and Jenin, and rainfed farming in the rest of the areas. (Pie Charts)

Although only about 10 percent of the cultivated area in Palestine, 5 percent in the West Bank and 60 percent in Gaza, is covered with irrigated agriculture, this type of cultivation, practiced by both Jewish Settlers and by some Palestinian farmers, could potentially have a negative effect on long term sustainability. Intensive discharge of ground water and use of fertilizers, pesticides, other chemicals and nondegradable materials such as plastics, present a threat to biodiversity as they are hazardous not only to the soil, but to all the surrounding plant species and wildlife. Definitely, all these practices contribute to the pollution of Palestinian natural resources including surface and ground water, land and air, clearly having a negative effect on overall biodiversity. Furthermore, because of the highly productive nature of this type of agriculture, there tends to be a uniformity to the type of seed stocks used, and a tenancy toward hybrid exotic gene stock rather than local.

One of the other problems with the intensive irrigation and water usage that has taken place since the middle of this century has been the deterioration of the quality of surface water and ground water sources throughout Palestine. One of the best examples of this is the Jordan River. Once the mighty river that flowed from Lake Tiberias into the Dead Sea, the Jordan has now been reduced, through the siphoning off of water at the river's mouth, to a fraction of its original size. Furthermore, largely because of runoff from sewage and the high input farms in the Jordan valley the water of the Jordan river is now highly salinized, so much so that it is unusable for the purposes of irrigation. Clearly this has a negative effect on the traditional plant life along the banks of the river.

Rainfed agriculture suffers from the opposite problem. This sector makes up 95 percent of the agricultural land in the West Bank and 40 percent in Gaza, but remains underdeveloped. There has been a dearth of research in the area since the 1970s, and the total agricultural department budget for research is 1,400 US dollars per year. One of the results has been that total cultivated area in the West Bank has fallen from 47 percent in the beginning of 1967, to less than 20 percent in 1994 (3). Also contributing to this was the lack of reliable markets, in large part because of Israeli restrictions, which has led to many farmers working outside of agriculture, and thus spending less time than might be necessary in maintenance of rainfed crops. It is also the case that tenure arrangements and restrictions on land use have diminished the size of agricultural plots, thus greatly diminishing the production potential for a given farmer. The combination of these things, along with often low amount of rainfall and variation in precipitation in different years,



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has meant that much of rainfed agriculture in Palestine operates at far below its development potential.

There are a number of sectors that need to be looked at in rainfed agriculture: field crops, forages and vegetables; fruit trees; and livestock and range management.

Field Crops, Forages and vegetables :

About 119,514 tons are produced each year from field crops and vegetables. While these sectors provide much of the base of the Palestinian diet, they have tended to fall short of meeting Palestine's needs. Currently Palestine produces only 15 percent of the wheat consumed, only 12 percent of the lentils consumed, and only 8 percent of the chickpeas consumed. Vegetables produced under rainfed conditions make up only a small percentage of the vegetables produced. Production of all of these crops fell significantly up until the Intifada, when there was an attempt by Palestinians to reclaim the land. Even since the Intifada, total cultivated area is significantly less than it was in 1967. In cultivated food crops this is due mainly to land and marketing restrictions and the resulting low return for farmers on their inputs. Because of restricted access to pasture land, and thus declining range stocks for animals, a major change in field crop/vegetable plantations has been the steady increase in areas allocated for animal feed, namely bitter vetch and vetch, since 1987.

Still, the genetic stock and different species available in this area is potentially quite diverse. We have good reason to believe that there is both species and genus variation of the major cereals and legumes guarded in situ by Palestinian farmers. Research done in Palestine and in the neighboring countries indicates that there may well be important wild relatives which grow in the pastures and wadis of Palestine (9,14,17). ARIJ's experiments have also shown that introduction of new varieties could significantly improve the production potential of rainfed field crops in Palestine (3).

Fruit Trees :

The total production of fruit trees, such as olives, grapes, stone fruits, and figs, is about 164,957 tons. The major fruit tree plantations are olive orchards, representing almost 77% of the total area of fruit trees under rainfed cultivation (942,000 dunums). In terms of production value, olives represent 20% of the average agricultural production. Almond and fig trees cover more area than grapes and plums and are scattered in the hilly mountains of the West Bank. Grapes and plums are concentrated in the southern districts.

Grape and plum trees are planted in intensive areas and require more care and attention from farmers than fig and almond trees. Figs' high per unit production value indicates the demand for this fruit although production itself is considerably low. Figs, like olives, can survive in the shallow soils of the hilly areas. In terms of value of production, grapes and



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plums suffer serious marketing problems (production exceeds local demand). Thus, as some fruits are in excess and others in demand, applied research endeavors will differ from one crop to another.

It should be noted that a major problem in the production of this sector is that they, in particular olives and almonds, have tended to be planted as a means of preventing land from confiscation by the Israelis. Farmers are often unable then to take the proper care of the planted trees, thus diminishing the production per dunum. Marketing also presents a major impediment for fruit producers, as they fall victims to Israeli export marketing restrictions. Problems also exist in terms of the adaptability of new varieties as they are introduced.

In all of the major fruit tree types, Palestine has native varieties which need to be screened, identified and classified according to their adaptability and resistance to moisture and soil diseases. These could well provide the perfect stock for improvement of fruit tree production in Palestine.

Livestock :

Livestock in Palestine includes: poultry; sheep and goats; and small numbers of beef and dairy cattle. Most rural Palestinian families have some form of livestock, which they use to provide dairy products, eggs and occasionally meat. However, livestock in Palestine has increased more slowly than population growth, resulting in a production shortage, especially in red meat. This sector makes up about 40 percent of the total Palestinian agricultural revenues (3,13). Restriction of the grazing area, mostly in the Palestinian Eastern Slopes ecoregion, has been the major reason for this production shortfall. Prior to 1967, grazing areas consisted of 400,000 to 500,000 dunums. This figure has declined sharply since the Israeli occupation, as 85 percent of the land has been confiscated or closed to provide for Israeli security and settlement needs. With such limited grazing areas available to shepherds, there is both an unsustainable ratio of livestock per dunum, and thus overgrazing, and higher production costs in the livestock sector due to the need to purchase supplemental feed. More recently there has been a decline altogether in the number of livestock in Palestine because of reduced marginal returns.

The closure of this area has also effected the ability of Palestinian scientists to study the Eastern Slopes, an area which with many of Palestine's over 2,500 plant species could be a gold mine in biological diversity and possibly provide the gene stock for future agricultural and medical advances in the Middle East region (3). The area is also an important crossing point for migratory birds and is the home of wildlife native to geographic Palestine.

ARIJ has already started the process of collecting and classifying pasture plants in Palestine. Significant work is still needed, however, to link this work with the livestock



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breeds in the area, and to classify these pasture plants. Because of the degraded nature of much of the currently available pasture land, special attention will need to be paid to the population dynamics, adaptability and potential for propagation of these plants, including shrubs and trees.

For this program to be successful, native pastoralists will need to be integrated as much as possible, since they understand the traditional uses of these plants, and often know their relative availability. Clearly, the existence of strong relations between forages and livestock makes integrated research of both important. Climatic conditions are the main factors affecting biomass and the existence of native plant species, which determines grazing capacity both in terms of potential animal density and range duration. As in situ plants are highly capable of withstanding local environmental conditions, these species should be given priority in terms of research, especially since they will be key components in plans to enrich natural pastures.

The size of the natural pastures are mainly dependent on human activities (such as building development) and the degree of livestock consumption (whether intensive grazing takes place throughout the growing season). Either case can limit the production of existing species, potentially leading to rangeland degradation, desertification, and the extinction of well adapted species.

The development is needed of a range management program which focuses on two main themes: obtaining maximum economic livestock production by using breeds with good production capacity in both meat and milk; and conservation of natural resources (particularly pastures). To achieve this, there must be the authority given to restrict grazing time and animal density in a given area. The introduction of suitable breeds of range livestock, such as Shami goats will be important in this endeavor as well. The Shami is a highly productive breed, in terms of kids per yew, growth rate, and production of milk. It has a high conversion rate from kilo consumed to milk or meat. Because of the shape of its mouth, it does not tend to be as destructive to rangeland as other breeds. As it is also a Middle Eastern breed, it will thus adapt well to local conditions and has in fact already been crossed with other local breeds.

Pesticides :

Farmers' use of pesticides in Palestine has increased significantly since their introduction here in the 1970s, in particular in irrigated farming. Unfortunately, this increase has not been accompanied by a full understanding of the impacts of pesticides on human health, beneficial soil organisms and micro-organisms and the environment as a whole (5).

A total of 123 pesticides are currently being used in Palestine. Among them, fourteen pesticides are internationally suspended, cancelled or banned, and seven which are members of the "dirty dozen", namely Aldicarb, Chlordan, DDT, Lindane, Paraquate,



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Parathion and Pentachlorophenol. All of these pesticides either come from or are shipped through Israeli companies, and most arrive in the West Bank and Gaza with only Hebrew labels, warnings and instructions. Very few Palestinian farmers read Hebrew.

Because of the economic value of the crops, pesticide use is much higher in irrigated farming. It is estimated that 96.6 percent of irrigated land is treated with pesticide. The total quantity of pesticide used is estimated to be around 1,471 tons per year, 730 tons used in the West Bank, and 741 tons used in Gaza Strip. The high consumption of pesticide in Gaza Strip is due the concentration of irrigated agriculture there. Soil fumigants (specifically Methyl bromide) are widely used in irrigated agriculture, and herbicides are increasingly being used in both irrigated and rainfed agriculture (5).

Clearly, as well as presenting major potential problems for the health and welfare of farmers, neighboring residents and produce consumers, the unregulated use of these chemicals is also detrimental to the area's biological and genetic diversity. Integrated pest management programs will need to be implemented as part of the larger strategy to maintain biodiversity.

Role of Women :

It must be recognized that women play an important role in the agricultural process in Palestine. Especially as more men are leaving the farm to work as laborers in Israel, women are picking up the burden in the areas of livestock production, weeding, and generally running the farm, as well as their traditional contribution of canning and sale of produce. Given this role, they must be integrated into programs to conserve plant genetic resources and biodiversity. Women are often as well, very knowledgeable about traditional uses of plants, which may be useful in classification.

Environmental Awareness and Biodiversity :

In reality the importance of biodiversity must be seen on the community level. However, this tends to complicate the job of promoting awareness. How can a scientist lecture the a community about the importance saving species of plants and animals, when that community is worried about the more basic issues of survival, either for political/military or economic reasons? This is particularly problematic if one takes the traditional view that conservation is best carried out through denying humans access to the land. On the contrary, increasingly global experts are coming to believe that the best ways to promote environmental awareness and biodiversity are to involve the local populations in the management of biological heritage sites, helping them to understand that their own interest is tied up in preserving the land and that which lives on it. Education and conservation programs need to begin now to achieve this goal.



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Certainly, there will be areas that will need to be restricted as much as possible from human economic and development activities, but this must be done in full consultation with the people living in the area. One of the dangerous legacies of the Israeli occupation has been that they imposed "nature reserves" on Palestinian land, in some cases putting settlements on those spots. The common Palestinian now has come to understand the closing off of areas for natural or historical heritage purposes as simply another means of confiscation and Israeli settlement. This is a problem that will need to be taken into consideration as environmental awareness and biodiversity awareness programs are launched in Palestine.

Certainly, there is a perceptible increase of environmental consciousness among Palestinians. Initiative has been taken in environmental education through the Education for Environmental Awareness program launched by a group of private schools in the West Bank. In Gaza an independent Environmental Protection Center was established in 1991 to monitor and address environmental problems and the Palestine National Authority has listed the creation of a Palestine Environmental Protection Authority as one of its goals. These efforts must be expanded to be shared at all levels, from the policy makers to the grassroots. But it is also exactly these efforts that we must tap into in promoting biodiversity. Still much of the Palestinian society is unaware of the importance of the environment in which they live. Biodiversity must fit into the larger goal of promoting general environmental awareness.

Challenges :

It is clear that now is the time for Palestinians to act in working to promote plant genetic resources and biodiversity. The following steps will be necessary **if Palestine is to meet this challenge. :**

1. The development of an herbarium and center for plant genetic conservation. This will be necessary as scientists collect, conserve, classify and screen native or wild varieties of different kinds of plants for the desirable characteristics. ARIJ has already started the process of compiling a complete flora and fauna database in the West Bank and has already done a survey of major rangeland plant species. Furthermore, ARIJ scientists have already started the process of collecting native strains of legumes and cereals for the purposes of classification.
2. GIS mapping of soils, flora and agricultural area will be useful in helping to identify locations suitable for the reintroduction of pasture plants. ARIJ is in the process of mapping climatic and rainfall data, as well as topography and geologic area.
3. This work should be integrated with a study of livestock animals in the West Bank, focusing on both indigenous and exotic species. A full understanding of livestock characteristics, traits and susceptibilities will be necessary for developing range management strategies. Estimates of numbers of animals and



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- their range needs will be essential to determining pasture land carrying capacity. In connection, more research will also be needed on the population dynamics native fauna that may be in competition with livestock.
4. A plant breeding program should be started to begin the process of adapting and developing new varieties to improve the production potential of rainfed farming in Palestine. Work has already been done on testing the suitability of Israeli hybrid varieties of wheat, chickpeas and sorghum at the farm level, but expansion of this work is greatly needed.
 5. Socio-economic work on the effects of gene stock and conservation programs on the local population will need to be done, with the hope of integrating those populations into the programs.
 6. Education programs will need to be carried out both with farmers and the general public, about the importance of conserving plant genetic resources and biodiversity. More sophisticated efforts should also be made to pass this information along to policy makers and planners.

To help in carrying out these activities, Palestinians continue to need training. With the idea of establishment of a national gene bank still in its nascent stages, now is the perfect time for Palestinian agronomists and botanists to receive training in gene bank organization, management, and utilization. Targeted programs would also be useful in conservation and utilization of germ plasm and seed technology. Specific areas of focus in this light should be: food and forage legumes; cereals, specifically wheat and barley; medics and other pasture plants; and stone fruits.

Conclusion :

Palestine is a special place, deserving of our most dedicated efforts towards her preservation. The rich diversity of her ecology mirrors the religious and cultural variety which converges within a compact area. What becomes obvious is that only a sound and healthy ecological environment can adequately host this rich gathering of ethnic variation. This will only occur if the human component in the inextricably intertwined ecological web plays a role commensurate to its status. The question, then, is how to proceed?

Clearly, the ongoing political stalemate and occupation prevents Palestinians from addressing the issue as thoroughly as might be necessary. Government action in all but a small part of Palestine, for instance, is simply not possible for the time being. Nevertheless, there is plenty to do in the interim -- in agricultural science and in public awareness, both at the level of the farmer and the general public. Even Palestine's economists must be reached and trained in the important concepts of short and long term "environmental accounting". Without this, efforts at promoting biodiversity will always be fighting a losing battle against short sighted cost-benefit analysis.



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Effective environmental management must involve the coordinated cooperation of many. Science and agriculture need to seek creative, ecologically sound alternatives, such as biological control methods and resistant crop varieties. Furthermore they need to recognize that the very basis of the work they are doing lies in the ecology around them. Real efforts must be made to promote genetic conservation efforts both in situ and in the laboratory and seed bank.

The challenges outlined above are daunting. Certainly the situation is far from optimistic. However, work is already underway to reverse the negative trend of the last 27 years. With the help of the international community, Palestinians can begin to contribute to the process of conserving biodiversity and genetic resources, combatting desertification, and ultimately improving the quality of human life.



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