

Review article*

Permaculture: Smart Growth Strategies and Management for Juniper Forest

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Abstract

Permaculture creates an integrated system by incorporating those parameters which are often viewed as separate entities such as smart growth, low-impact development, habitat protection, complete streets, and other initiatives. Its gives better planning options and give policies a line of coherence and directions which provides basis for the real concept of sustainability. Presently in Pakistan, forest management policies suffer from a number of drawbacks and especially the Juniper forests in Pakistan are under constant pressure due to natural as well as anthropogenic pressures. To conserve the Juniper Forest Ecosystem a proposed Smart Growth Strategies based on Permaculture's principles are designed to protect the Ziarat Juniper Forest that offers an unequivocal vision and strategy to gain valid sustainability in forest management.

Keywords: Sustainable Forest Management, Application to Principles of Permaculture, Strategic direction, Ziarat, Juniper Forest

Role of Juniper Forest in Socio-Economic Sustainability

Juniper forests ecosystems (JFE) are distinctive and oldest woodlands on the surface of the earth that are found in arid and semi-arid regions around the world (Farjon, 1992; Bekele, 1993). There are fifty two recognized species of juniper tree found in various parts of the world (Adams et al., 2003; Pourbabaie et al., 2006; Pourmajidian and Moradi, 2009; Zaidi, 2012). They are famous for their slow growth rate i.e. an average age of a tree is more than 1500 years and they grow only one inch per year and are referred as "living Fossils". Juniper forests provide both tangible and intangible values (ecological, social and economic). These values are classified according to ecological values such as climate stabilization, soil enrichment and protection, regulation of water cycles, improved biodiversity, purification of air, Carbon dioxide sinks and are also potential source of products for the pharmaceutical industry; for example Juniper cone-oil is used to treat many diseases such as tuberculosis, jaundice, eczema and also used as pain-killer, antiseptic, and tranquilizer (Derwich et al., 2010; Orav et al., 2010). Social values include tourism; landscapes of high cultural, spiritual value, recreational & leisure area, etc. Economic values to the communities include employment, trade of forest products and investments in the forest sector etc. (Akhtar et al., 2014).

Globally, Juniper forests are exposed to variety of anthropogenic and natural risks calamities like acid rain, dwarf mistletoe; overgrazing, invasive, exotic plant species, fire, storm and agricultural encroachment etc. (Blot and Hajar, 1994; Miskell, 2000; Borghesio et al., 2004; Patzelt, 2015; Fisher, 2009). Declines of Juniper Forest Ecosystem have been reported in Europe, America, Africa, Spain, Saudi Arabia, Arabian Peninsula, Oman, Morocco, and Pakistan (Gauquelin et al. 1999; Munoz-Reinoso 2004; Laila Al Haddabi and Reginald, victor, 2016). Despite continuous efforts by the world community to save the Juniper Forest curb this problem, Juniper Forest Ecosystems are declining in most parts of the world causing serious consequences for the human livelihoods, ecosystems, and global climate.

Due to the globalization which resulted in extremely competitive, business environment has made it compulsory for researchers to find out new and novel approaches for forest protection. Presently; Pakistan has deficiencies in forest management policy and the current practices of forest management suffer from a number of drawbacks. Conventional forest management practices adopted in Pakistan are generally based on short sighted approach which reduces the capacity of forest management and are not capable to adapt the philosophy of sustainable development. In practice; sustained yield of wood was the only concern of sustainability and policy makers gave priority to economic factor and other parameters such as environment and social issues are viewed as apart from society. Thus it has become an urgent priority to modify traditional management systems that have lack of strategy management structure, measures and approaches. Therefore to protect the Juniper Forest ecosystem new Permaculture based Smart Growth Strategies are needed that will combine economics, ecological and social factors for effective and sustainable development.

Permaculture an Introduction

The word Permaculture means permanent agriculture that presents up-to-date aboriginal ecological knowledge for the creation of a consciously-designed, integrated, self-sufficient system that intend to increase biodiversity, reduce energy requirements and to recycle resources within the system. Permaculture principles are based on ethics, equitable interaction with environment and system design principles that offers an unequivocal vision and strategy for valid sustainable management (Mogen, 2006; King, 2008). These principles are grounded on the study of natural systems and provide source for continuous evaluation and creation of the unequivocal solutions essential to modification away from the unsatisfactory execution of sustainable management to a balanced interaction of human and environment.

The Permaculture focuses on small scale management that promote sharing, escort by a lack of concern with market recognized forest certification. The key objectives of Permaculture are environmental flexibility and vital rehabilitation which makes it suitable for over-exploited, marginal and degraded soils and water areas. A fully functioning and well planned Permaculture design is suitable to area where, as an effect of over population, family bear a large number of dependents, making time and energy for household fuel, fodder and food production is a vital consideration (Akhtar et al., 2015; Akhtar et al., 2016). These principal features differentiate Permaculture from other management systems.

Principles of Permaculture

Basically; the Permaculture promotes the concept of sustainability through the conceptualization of balancing human interaction with each other and nature. The ethical origin of the theory is “care for people”, “care for the Earth” and “redistributes assets excess to one’s own requirements” (Mollison, 2002). The fundamentals of permaculture are the ethics that are placed at centre which

guide the implementation of the design principles, confirming that they are used in proper ways. These principles are universal thinking tools and can easily be utilized to ingeniously re-design our environment, society and economy in a world of less energy and meager resources. The strategies used to apply these principles differ extensively reliant on the social, economic and ecological site conditions and available resources. The principles of Permaculture are divided into three categories:

Energy and Living Principles

The sustainability debate has shown a deep confusion about the procedures and structures which maintain social, economic and ecological systems. The lack of eco-centered strategies to integrate earlier ignored environmental "givens" into strategies developed by economists and decision-makers is painfully obvious. There is no simple answer to the multifaceted question of costs, economic benefits, and sustainable development. Conversely, there is a natural currency that can be utilized to measure our interdependence on environment and assist to make sustainable strategies about existing and future action-That currency is energy. The Energy and Living principles are further divided into eight principles:

1. Energy Input
2. Energy Cycling
3. Energy Efficiency
4. Intensification ion
5. Diversity
6. Succession and Evolution
7. Use Biological and Renewable Resources
8. Edge Effect

The principles of energy and living emphasize on observation of natural cycles to determine energy flows and process to lesser the establishment and maintenance inputs. Cautious and extended observation earlier to action can reduce on-going energy inputs and the systems that develop should sustain and take least maintenance. Key energy source within permaculture systems is the sun. It produces wind, precipitation and biomass. By developing systems that collect incoming energy (sun, wind, rain, manure etc.) at peak abundance before they degraded and lost to entropy, can be utilized in times of need. In permaculture systems efficient energy design is developed through zone, sector, appropriate placement of elements and structure. Most creatively and originality comes from the edges of society (Identify, create and utilize edges) that consumed by the masses.

Functional Design Principles

Functional Design Principles leads to Stability and Resilience by integrating functional diversity and biological fertility through mimicking natural eco-systems. These principles focus on establishing efficient relationship between components of relative location and their proper placement in a system so that it performs as many functions as possible. Valuable connections between various components create a sustainable and diverse ecosystem, not the number of elements. Diverse and productive systems act resilient in the time of need. The four sub principles of Functional Design Principles are:

1. Support
2. Multi-functionality
3. Relative Location
4. Stability

Attitudinal Principles

Attitudinal Principles' are people-focused and deal with our attitudes: How people look at a 'problem' or a 'valuable resource', depends on their attitude. Usually, individuals perceive a disadvantage as a 'problem' and then implement an energy-intensive solution to attempt to fix the problem. The Permaculturist has a different attitude that looks at everything as a positive resource, and figure out how to make use of it- for example- can turn these disadvantages into useful resources through knowledge of system and elements of nature. It doesn't matter how well policy makers can develop the site design/policies and how efficiently it all works, there are always ways to improve and add to the system. The number of ways that resources can be utilized in a system is limited purely by the information of the policy makers. The only limit to the number of uses of a resource within a system is limited to the information and imagination of the designer. The four sub principles of Attitudinal Principles are:

1. Mistakes are Tools for Learning
2. Get a Yield
3. Turn Problems into Solutions
4. The Biggest Limit to abundance is Creativity

Design of Permaculture

The three ethical doctrines are measured the same in precedence, with a stress on value for all living organisms. It also signifies that human kind should be ready to give back what is taken from nature to conserve it for upcoming generations. Permaculture alleges to inquire about the environmental crisis as a whole; examine how the elements are interrelated; and propose enduring sustainable ways to fix the systematic problems. These comprise identifying natural patterns in environmental structure, natural web of life and learning from history mistakes. Therefore the key aim of the philosophy of Permaculture is to produce sustainable human environment by following ecological patterns' (Burnett, 2008). The suggestion to observe natural patterns is not an anti-technological standpoint, while Permaculture incorporates to explore the alternative appropriate skills and technologies that work with natural system. The Permaculture methodical design that provides guidelines to developed policy is shown in the figure-1



Figure 1. Design of Permaculture, Source: Compiled

Methodological implications of the Permaculture

To apply Permaculture a "site" or location is selected. The physical space or site consists of urban or rural area, woodland, home or any selected place. The process of incorporating permaculture's ethics and principles is referred as "site design". The Methodological implications of the Permaculture is shown in the figure-2

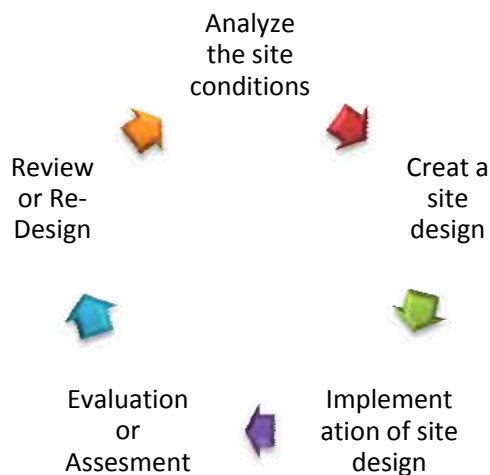


Figure- 2. Methodological implications flow of Permaculture Source: compiled

Observe and analyze the site

Every site is unique and has dissimilar social, economic and ecological conditions. The key to developing an effective, balanced and self-sustained system without a lot of human intercession requires extended periods of observation and analysis of the specific site conditions. Permaculture accentuates the interrelation among all social, economic and ecological elements in a system. It is not something that is created in isolation, but through constant and shared collaboration with the site elements. For effective functioning of a management system components must be placed in the right place (Mollison and Slay, 1991). The following steps are taken to analyze the site conditions:

- **Specify the ecological characteristics of the site:** - Analyze the physical, biological and chemical parameters of the site such as its climate, precipitation, wind, energy topography, soils, water, exotic and native species and biological diversity.
- **Analyze the social factors:** - Such as indigenous community, their quality of life, their material and non-material resources, how dependent they are on their natural resources, conflicts between stakeholders, public rights, law, legislation, institutional arrangements, infrastructure, pedestrian traffic and means of transportation etc.
- **Evaluate the economic factors:** - Investigate about the cash income, non-market income, survival values, and asset trades, per capita income, poverty, unemployment, obtain ability and access of life existing facilities and source of energy etc.
- **Analyze according to zones:** - Zones are a further concept concerning to put ecological, social and economic essentials on a right place. Zones are figured as of 0 to 5. Each zone is determined on the basis of the frequency of use and requirements. Elements which are used most frequently or need more consideration would be positioned in zones 1 and 2. Less influential elements are farther away.

- **Examine consumption and production of the site's elements:** - What will all components generate or add to the location? How many assets will it use? What type and how much effort are required to sustain it? Permaculture is a holistic and dynamic approach and focused on enhancing valuable links between elements and synergy of the ultimate plan. However, Permaculture seeks to reduce labor, waste and energy input by structuring systems with maximal settlement among proposed essentials to accomplish a high level of synergy.

Site selected for Application of Permaculture Study

Ziarat is the capital of Ziarat District, Balochistan, Pakistan. It is located at 30° 22' 51 N, 67° 43' 37 E. It is a knoll resort at an elevation of 2336 meters (7662 feet) above sea level. The total geographical area of Ziarat tehsil is 1489 km² and lies at an altitude ranging from 2000-3000 meters. Due to high altitudes Ziarat experience more sunlight, wind speed, less moisture and ultraviolet radiation. The open grown, pure multi-storied and scattered stands of dry temperate juniper forests are extending over three different districts of Balochistan, a) Ziarat, b) Harboi and c) Zarghoon. In Ziarat the largest contiguous natural Juniper forest are straddling 247,000 acres as well as these are the second oldest forest assets after California, in the world with vital scientific, ecological, geological, economic, socio-cultural significance and not only for Pakistan but for the global community. The rate of deforestation for juniper forests is 7% per year (Khan, 2012; Achakzai, 2013). Elevated deforestation and low rate of regeneration are the major threats of Juniper forest (Ahmed et al., 1990b; Gülsoy and Özkan, 2013). Beside that lack of alternative energy resources is also threat to the existence of these forests. The population composition and dynamics of Juniper forest in Balochistan have remained almost unidentified and lacks of comprehensive quantitative environmental researches have not up till now been available on juniper forests.

Management Deficiencies in Juniper Forest Ziarat

Ziarat Juniper Forest Ecosystem has global significance, it is a national heritage and any management system cannot work effectively without the sufficient motivation of the people. In Ziarat local population have lack of participation and involvement to protect the Juniper forest. No sincere measures are taken for decreasing the traditional reliance of the local population on forest services and their products by the government or other international organizations.

The Government Forest Department only consider the conservation of juniper forest and not its management. The structure of the department is more focused on command and control. In forest department the majority of the staff is unskilled and have lack of motivation. The major flaw in existing management system is corporation among various government departments such as agriculture, environment, livestock, wildlife and irrigation etc., to developed and implements sectorial policies. The activities of these departments are mainly focus on unsustainable land utilization such as encroachment and conversion of forest land into fruit orchards, excessive water mining for irrigation, excessive use of chemical fertilizers and pesticides to increase the yielding and income etc. these unsustainable practices not only give threat to juniper forest ecosystem but also to the natural environment. In the past; management issues are not considered adequately by these departments.

In Juniper forest of Ziarat the biodiversity and their habitat particularly the predators have been reduced and threatened significantly. The birds such as the "Dark throated" are being exterminated. These birds are of vital importance in germination of seeds in the Juniper forest ecosystem. Nevertheless, there is no serious efforts are made to protect these biodiversity either through public

or government departments or any non-government organizations. Only management action plan that is taken to protect these biodiversity is watch-n-ward action and build protective fencing.

The free grazing by the livestock destroys the natural regeneration of juniper trees. The collective grazing of domestic livestock with wild species increases the infection or illness among animals as well as in their habitat. The edible plant species and medicinal plants of rangelands cause intimidation to the extent and quality of wild ungulates fodder. The ecologically viable management plan of rangelands according to their grazing potential to protect the biodiversity from the harmful effects have been lacking till now.

Rangeland degradation is a major problem in Ziarat causing ecosystem instability, change in species composition, and reduction in vegetation cover, soil erosion and amplified susceptibility of poor rural communities (Ahmad et al., 2012; Islam et al., 2013; PARC, 2014). The caring capacity of rangelands is two to three ha/ewe. Overgrazing is also a source of the spread of parasitic, invasive, exotic plant species.

Dwarf Mistletoe; a parasitic seed plant that had damaged Juniper Forest Ecosystem in Ziarat developed into an emergent menace to the juniper trees (Akhtar and Mirza, 2006, Sarangzai et al., 2010). Dwarf Mistletoe is completely reliant on Juniper tree for food, shelter and reproduction. Approximately 3,500 ha, about (4%) of the total area of juniper forest was reported infected by Dwarf Mistletoe (Sarangzai, 2004).

Traditional dependence of pastoral communities especially the nomads on JFE and unawareness about the significant role and functions of JFE at all levels between the major stakeholders caused overexploitation of forests. There has been insufficient management focus on this feature.

There is no proper city planning in the district and the houses are built with no sanction of the municipal management. Style of living in Ziarat varies due to the topographic uniqueness of different parts. In the hilly area, housing settlements are scattered, small and generally have a tin or bark roof. Whilst in even parts, the dwellings are comparatively larger. In rural areas, the quality of construction is poor, majority of the houses are without proper sanitation systems and piped water facility. About 34.7 % population in Ziarat use sanitary means of waste disposal and 62.2% households were without latrines.

Another sector that is neglected field in Ziarat is Tourism. Tourism plays an important role in increasing public consciousness about the significance and conservation of JFE as well as can be develop as a source of livelihood diversification. It can also be a good source of revenue generation and this revenue can be consumed on sustainable development and protection Juniper Forest Ecosystem.

Permaculture Principles based Smart Growth Strategies to Protect the Juniper Forest Ecosystem

Permaculture smart growth strategies are connecting system that integrates latest technologies, politics, society, psychology, and the diverse experiences and resources available in any community. It integrate the sustainable elements (e.g. water catchment, renewable energy, district heating, food growing, waste recycling, transportation, etc.) into a whole system that operates efficiently. In Permaculture the numbers of inputs are minimized and outputs attained are maximized. The goal of permaculture is to create an ecosystem that provides as many useful products and functions out of the system while healing the planet. Due to this integration Permaculture differs from other management systems. Ziarat's Juniper Forest Ecosystem faces number of management issues that represent the overall situation in terms of periodic evaluation, amendments, asset availability, threats

etc. therefore synchronized Permaculture based smart growth strategies are applied to save the national heritage.

- Permaculture can be implemented effectively in Ziarat valley through the design concept of zones and guilds to maximize resources and create a self-regulating system that functions with nature to produce both the foodstuff and natural resources essential for all living and non-living organisms' existence.

- By implementing community based management system, participatory culture and indigenous knowledge of economic, ecological and social governance, individuals feel much more a part of their communities, and feel as though they have some influence on the things that directly affect them. It is also a guiding Strategy for social change. Through cooperation, combining their indigenous skills, assets and learning form one another; communities harness their fortes and collaborate, instead of current financial systems established on competition prompts. Everyone in a society has diverse skills, abilities; ideas and interest. These are all assets that can be employed to benefit the society as a whole.

- By applying the energy and living principle of Small and Slow Solution create more resilient ecosystem, Permaculture promote community participation to increase vegetation cover through developing community forests on Sailaba land (flooded land) and encourage the low delta forest trees such as Robinia, Tamarix, Sinjid, Ash, Acacias and Prunes. The Tomagh (Ziarat) site has better recovery potential of range vegetation due to occurrence of both winter and monsoon rains.

- Permaculture provokes all components within a system to collaborate for the benefit of the society as a whole. It advocate to developed smallholder farming systems such as Community Gardens, Community Supported Agriculture and intercropping. In smallholder farming systems, the local community will be able to increase their financial position; particularly women can have more time to follow other activities. The main features of the designed are based on partnership between farmers and customers who share the risks and benefits in food production. Through this process, customers expect to benefit by receiving healthy, organic victuals and farmers advantage through possible ways of marketing.

- Rainwater harvesting is one example of applying permaculture principles of energy and living. Permaculture site design provide guidelines in developing sustainable systems by collecting and utilizing natural resources when they are copious, it can be used in periods of needs such as by storing rain water in mini dams, rooftop systems and from dew or fog with nets or other tools can be developed with the co-ordination of local community, private and public sector with minimal skills, to mechanized structures that entail modern system and installation. It is potable water and can also be utilized for irrigation, livestock, and groundwater recharge (karezes) in arid environments. GIS maps can be developed and utilized to identify the sources and for the estimation of community's water needs especially in drought periods.

- The Permaculturist Compost management systems (Compost basket) can also be practiced as a joint venture of government and local community in Ziarat valley to increase vegetation cover and to conserve JFE because the compost is rich in nutrients and beneficial for the acreage. It can be tilled directly into the soil to increase the fertility of the soil and also works as a soil conditioner, an organic fertilizer, addition of humic acids, creating habitat for soil organisms, suppressing weed growth and seed germination, moderating diurnal temperature swings, a natural pesticide, protecting against frost and reducing erosion and as watercourse retrieval.

- Establish Monitoring & Evaluation System, baseline data on social, economic, and ecological indicators should be integrated into a comprehensive Permaculture site design. Limited data might not help decision makers in policies formulation and improved legislation for forest land, encroachment, conversion and land tenure system. The institutional system for successful execution of the plans and policies to assess the impact of the natural and anthropogenic pressures on JFE suffered due to inadequate monitoring and reporting systems and for lack of skilled staff. Trying to introduce quick, major modification usually results in failure, because social, economic and ecological systems are multifaceted webs of integrated phenomena, slow and small modifications allow the whole web to adapt the change before the next is made. Small and slow solutions also allows for monitoring and assessment.

- Permaculture promotes latest techniques in monitoring and evaluation. The GIS monitoring system, Remote Sensing System, directory, inventory system should be developed and monitored on regular basis for the evaluation of social, economic and ecological perspectives. The systematic and scientific monitoring system provide baseline data for the development of criteria and indicators, information about the consumption, exploitation, forest land, encroachment, conversion, demarcation of forest land and policy initiatives. This data can also be compared with the established national and international standards and planned targets (Solaimani and Shokrian, 2011). The evaluation will warn if the equilibrium is disturbed or the sustainability of the asset is threatened. This information should be discussed on national forums and it will enable the decision makers to review their policies according to the provided information or to offer new amendments to improve the planning, targets, conflict resolution and implementation.

- Traditional dependence of indigenous communities and over consumption of JFE for construction houses or as energy source can be minimized by developing various strategies under the attitudinal and functional design principles of PC such as change in local construction style of houses. Straw-bale houses construction system can be adopted because it offer benefits such as seismic reinforcing, fireproofing, healthier living through higher levels of thermal insulation and regulation of humidity levels or as an aesthetic element for a more natural look.

- There are conflicts between local communities on natural resources consumption, responsibilities and benefits. Problem solving, conflict resolution, and improved stewardship are necessary for indigenous communities to sustain. Permaculture incorporates care for people aspect by approaching conflict resolution through ecology, systems thinking, and comprehensive analysis. A Permaculturist concentrates at nurturing human interactions also, as in garden designs. It focuses on nature patterns and relates those patterns for care for earth. Similarly it looks for social patterns and applies those patterns on care for people. Hierarchy is a common social pattern of command and control system, by working collectively we come across with various conflicts and challenges. Identifying and removing them can develop effective social structures. To develop a collaborative culture of respect, trust, feeling of belongingness and shared responsibilities help in resolving conflicts of land ownership and resource utilization of the people of Ziarat. All the stakeholders are involved with responsibilities before the implementation of any community based management interventions. The attitudinal principles are information intensive and depend heavily on indigenous social and cultural knowledge, information and observation about the societies that we are designing with. Community based discussion programme also be arranged to resolve the conflicts. It will really helpful especially in specific cultural circumstances (Jirga system- communities/ local people to solve the problems with mutual cooperation) of Ziarat. Aboriginal people practice customary laws, which often contradict with the regulations followed by forest sector. These and other community conflicts

can be solved through frequent interaction and community based discussion programs. Nomads should be the part of these programs.

The social, economic and political sustainability articulates well with the help of permaculture based smart growth strategies that encourage modern individuals to take responsibility for their own actions, reduce their consumption and waste, and live a more ecological lifestyle, thereby enacting a more democratic and fair division of and access to the world's environmental resources. The systematic presentation of Smart Growth Strategy based on Permaculture Principles in Ziarat, Pakistan is shown in figure-3

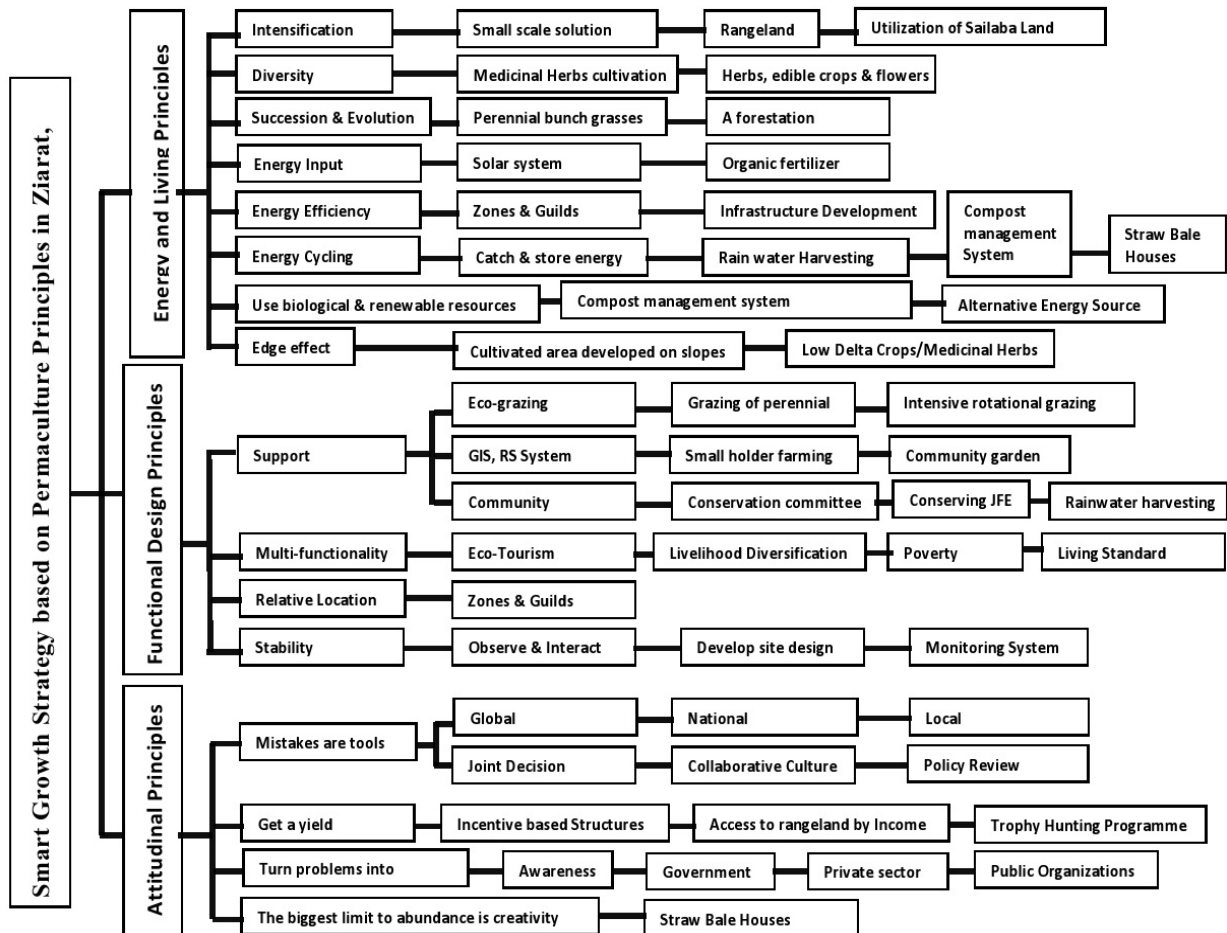


Figure-3. Smart Growth Strategy based on Permaculture Principles in Ziarat, Pakistan. Source Compiled.

Conclusion

Utilization of natural assets to the best efficient level without changing natural balance has become a critical issue for researchers as awareness on climate change takes central position in global debate. Conventional sustainable resource management systems are based on neoclassical economic approach that ignores the nature's pattern and therefore are not actually capable of sustainable management of resources. The relationships between decline in Juniper Forest Ecosystem

and its related driving features are often obscure and nonlinear. In future if this situation continues over-exploitation of forest asserts will difficult to control. Therefore Environmentalists are lately advocating incorporation of permaculture as holistic approach based on ethics, equitable interaction with eco-systems to obtain sustainability.

Smart Growth Strategies based on Permaculture Principles are grounded in the sustainable management of systems ecology, landscape geography and socio-economic development. The overall aim of these Strategies is to develop closed-loop, symbiotic, self-sustaining social environments and production systems that do not result in environmental degradation or socio-economic inequality. While the strategy of such systems is essentially dependent on the specific indigenous environment, therefore Permaculture based strategies provide general guidelines for considering socio, economic and ecological indicators and arrangements in designing forest ecosystem, farms, livestock operations, aquaculture systems, community, and urban areas. The key aim of Permaculture based Smart Growth Strategies is to create a self-managed system and provide quality of life by designing a contained the natural systems. In modern societies the policy are designed by the policy makers who have little indigenous knowledge, that why people often feel that they have no role in decision making. By implementing community based management system, promoting participatory culture and utilization of indigenous knowledge of economic, ecological and social governance, individuals feel much more a part of their communities, and feel as they have some influence on the things that directly affect them. Thus Permaculture's Smart Growth Strategies promotes ingenuous human system based on natural ecosystems which are self-sufficient and self-regulatory.

The Permaculture's Smart Growth Strategies can set new guidelines for eco-management that will address the missing gaps to provide a sustainable management system of the Ziarat Juniper Forest Ecosystem. The Approach involves all stakeholders at all levels (federal, provincial, local) in policy development, implementation and review process. Stakeholders active and lively participation will help in conflicts management among the governments (provincial, federal) such as excise duty on inter-provincial movement of wood, remunerate for watershed conservation, harmful effects of the ban on logging in protected areas, and biological diversity protection, reduced conflict between the forest and other departments. It also alters the traditional forest management system with ecosystem-based classification and help in establishing the sustainable forest management system according to the global scenario.

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