

Eco-Zero Weeding - A Wow Incredible Scientific Innovation for Altering Things around Us and India Inaction

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Abstract Weeds grow everywhere and create crop loss, involve huge expenditure in weeding, produce allergenic pollens and unpalatable fodder, forages and cause green house gas emission in environment around us. Several high tech weeding machines including robotics were developed and focused as wonderful development and marketing strategy created to make huge profit in the global business by many developed countries forming company consortium to harness the benefits from such unaffordable technologies. Further, these weeding machine based practices are not suitable where sowing is done by hand broadcasting, as is prevalent in eastern India and many countries of the world, as well as under aberrant weather condition making field condition not walk able or too dry condition for any field operation. Hence, problem of weed management and global warming are not likely to get solved by such technical developments. It requires some miracle like discovery to stand as panacea scientific solution. The present study reports an innovative research on science of ecology that becomes a non monetary panacea total solution in agriculture and stands as method of weed management superb over any known mechanical-robotic weeder getting claimed as breakthrough on weeding works. This innovation was submitted to Indian Council of Agricultural Research, New Delhi over a year ago i.e. on August 17, 2017, as fulfillment of a challenge on weed management, but it is pending due to inaction. The new science based discovery not only overcomes weed control under all conditions, including the broad casting situations, as well as aberrant weather condition, but eco zero weeding fixes atmospheric natural nitrogen that enhances unimaginable high yield of crops. This discovery equips world with intellectual property of immense value that enable world acquire huge economic gain and overcome climate change and foster environment protection.

Keywords: *crops and cropping practices, eco-zero weeding, weedicides, mechanical weeders, robotic weeding and weed management techniques*

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1. Introduction

Weeds cause competition with agricultural and horticultural crops. Studies [1] have established the loss in different crops and crop varieties. This classical study established the extent of crop losses under different situations.

Study at low nitrogen containing soil (20 Kg/ha) at Giri Dih, Jharkhand, India with low productivity red soil revealed the ranges of crop loss due to presence of different composition of weeds. Crop yields are high for wheat, followed by barley, rape seeds and lentil. The study presented data on different ranges of cereal viz wheat and barley and oilseed viz linseed and mustard. The study had not included treatment containing pulses. However, it contained alfalfa which is nitrogen fixing fodder crop as weeds. In the treatment which was devoid of N fixing crop,

the loss in productivities were of the highest order for the respective crops; being the maximum for barley among cereals followed by rape seed among the oilseeds. When only alfalfa was present the crop losses due to weeds were the minimum for all categories of crops; wheat showed highest tolerance for crop loss among cereals and linseed among oilseed, which has low productivity potential. It was also revealed that mixture of weeds reduce loss in crop against that without any N fixing plants.

The studies were conducted in regions where only mechanized weed control operations can be thought over. But, under many situations, the lack of seeding machines viz seed drills compel sowing of crops i.e. by hand based broad casting. Thus, under such conditions weed management is complex, costly and generally not done, leading to high crop yield losses. For such situations weedicides are used for killing weeds, which cause adverse impact on soil, crop, runoff water and environment. Thus, finding a

feasible and practical solution remains a distant dream. These complexities became challenging task as the weeds

rob away resources and any effort will mean huge cost and that will reduce net income to the stake holders and farmers.

Table 1. Losses in crop yield of different types of weeds on various crops (Experimental study at Giridih Jharkhand, India)

S.No	Treatments	Yield, Tonnes / ha			
		Barley	Wheat	Linseed	Rape seed
1	No weeds, manually weeded	3.54	5.14	0.71	0.87
2	All other weeds, except alfalfa	1.9(-46)*	2.93(-43)	.54(-.24)	0.56 (-36)
3	Only alfalfa	2.57(-27)	5.54 (-12)	0.66(-7)-	0.73((-16)
4	Other weeds +alfalfa	2.56(28)	3.53(-31)	0.61(-14)	0.66(-24)

Figs in the parentheses are % reduction in yield due to weed, Source [1].s.

The objective of the present study was to develop a universally applicable, affordable, feasible and scientific weed management practice, which will not cause any adverse effect and remain working under adverse weather conditions viz, field not remains walkable during wet condition and no tillable during drought condition, At the same time the weed management should be cheap, lucrative and adoptable by all socio-economic levels in the agriculture and horticulture world over.

2. Materials and Method

2.1. Weed Control Practices

Weeds grow before any seed of crops grows, hence the weed had been a universal problem in agriculture. There have been manual, mechanical and weedicide based approaches to reduce crop yield losses. However, while the problem had been universal, no scientific solution had so far emerged. The weedicide based weed suppression has caused environmental damage. Only some advancement has been created in developing automation in weeders involving mechanical cutting, slashing, uprooting or flamed burning mechanisms viz mechanical and robotic. Some machines are also developed, which reduce load of weedicide. Since these advancements had been very recent, a brief account is made to appraise the readers the potential of different weeders and limitations of such advancement on weed control.

2.1.1. Eco Weeder / Weeding Machines [2]

Eco Weeder [2] is a treasured advantage for conventional and organic farmers. Asa-Lift offer Eco weeders in 2 variables to fit the specific needs of the land owner. As claimed, an Eco weeder will save time and money. The Eco Weeder brings effective mechanical weeding in all kinds of row-cultures. Mechanically driven rotors remove the weed in the row as well as between the rows. For efficient weeding in the row, the rotors are manually adjusted. The weeding machine is easily adjusted for removing weed in the row and covering the weed in the row with soil. A range of options are available, in order to optimize the machine for different crops, row distances and bed systems. Eco weeder can be delivered as 1 or 2 row machines. Capacity up to 2.5 hectares a day, for a 1 row weeding machine (depending on row distance) are available. The machine is mechanically driven by tractors PTO shaft. Machines can be delivered

with an "off set" frame unit, in order to adapt the machine to the row distance/ bed system. Minimum row distance is 30 cm for a 1 row machine and 75 cm for a 2 row machine!



Figure 1. Lisa lift one- 2 row eco weeder, Tractor PTO driven weeding machine [2]

2.1.2. Giant Eco Weeding Machine



Figure 2. Giant eco weeding machine, developed in European country. ICAR Ministry of Agriculture building Krishi Bhavan have placed this giant machine picture in the reception lobby as a symbol of progressing advancement in agricultural research

2.1.3. Eco Robotics' Autonomous Weed Cutter [3]

According to company [3], the farmer's investment on the robot will pay off in 5 years. This claim comes because of the Robot's highly efficient design and a long list of features such as: autonomous operation; GPS navigation, Solar power (12 hours of working time), non-hazardous, light weight design to transport on tractors and 30 % cheaper than standard sprayer.



Figure 3. EcoRobotix's Autonomous Weed Cutter Developed in the canton of Vaud, Switzerland [3]

2.1.4. Solar Lawn Weeding Machine [4]



Figure 4. Solar lawn weeder for slashing weeds in lawn [4]

This weeder is useable for lawn or unsown fields. It has limited application. Entire merit lies in the power source of solar energy, hence cost of power source is eliminated.

2.1.5. Flame Weeding [4]



Figure 5. Flame weeding

Propane flame weeding is an old known method of killing weeds by bringing flame close to the weeds (Figure 5). In this process crop plant in vicinity of weeds also get damaged if care is taken, lot of weeds remain in

field and stand robbing the nutrient and bringing adverse effects. This method is claimed to be environmental friendly as it is operated in lieu of weedicides. The Organic Farming Research Foundation opines this method of weeding highly suitable for organic agriculture.

2.2. Design Consideration

The weeders so far developed are weeding mechanically, driven by tractor PTO. The Robotic weeding machine is solar powered, GPS control which will be moving in field and work for 12 hour. This implicates that the field sizes should be large and crop sowing should be in rows. In most of developing countries the field sizes are small and row cropping also not practiced. Thus the advancement in weeding machines, which had been the only advancement will not be useful beyond the developed countries. Thus, there is need to develop weeding method which could be useable in developing countries as well under all practices of sowing row or even broadcasting resulting no regular rows.

The weeding practice should be applicable for all stages of from fallow, followed by sowing till harvest under any of bad weather condition and field condition of walkability and till ability. It should be feasible, practical, not demanding large no of labourers for repeated fast growing weeds. In consideration of these requirements and design considerations a new technology was developed.

2.3. The Concept and Experimental Studies

2.3.1. Concept

Data presented in Table 1 [1] revealed that when some leguminous crop is introduced in the main crops, it will suppress the weed growth and reduce the yield loss due to weeds. This type of idealistic measure will be eco based method. Inspired by the discoveries [5], this author pursued the refinement of new concept and planned experimental research studies to find supporting crop combination that will bring substantial control in loss due to weeds. Thus, an optimum situation of eco was investigated.

The nitrogen fixed by the companion crop will enhance yield in addition to reduction in crop loss, there will be tremendous increase in crop yield. Thus, the new concept surpasses any advancement going or being claimed by the weeding machineries, be it mechanical or robotic. The study experiments were conducted to accomplish this aspect.

2.3.2. Experimental Details

For conducting experiments for new scientific method crops and cropping practices were ascertained. The main crop can be either, cereal, oilseed or even pulse crop, but for weed control invariably the companion crop should be a pulse crop. Different indices for suitability of companion crops had been developed. For rainy season's crop they could be green gram or the black gram. For winter season cropping the companion crop should be lentil. There can be several suitable combinations, but management of the nitrogen cycle [6-12] guides this selection of companion crops for the weed control.

Field experiments [14,15] were conducted for finding the density of eco where the yield of main crops were the

maximum. The data obtained from ranges of eco established with legume crop were 0, 25, 50, 75 and 100% of normal seed rates sown as a sole crop of the pulse crop, Results of the eco based study will be presented in result part of the study.

2.3.3. Submission of Challenge Accomplishment on Eco-zero Weeding Agriculture

An application had been filed with Award Cell of Indian Council of Agricultural Research, Krishi Bhavan, Ministry of Agriculture and Farmers Welfare, Government of India, New Delhi, on August, 16/17. 2017. The application is to be considered under item 2 of the prescribed proforma of submission. The research submitted is as entitled, "Innovative application of scientific principles of Environmental Sciences and Environmental Engineering in Agriculture (Non monetary and maneuverable eco-zero weeding agriculture). Several research articles have been published in International Journal of reputation. But, even after lapse of one year of submission no action has so far been initiated in India due to inaction on research results of such high merit. On the other hand, many European countries have been developing weeding machines and making claims of technological breakthroughs provoking huge claims and poised to make big global businesses.

3. Results

3.1. Experimental Study on Garlic

The results of study on eco based weed suppression in field of garlic [14] is contrasted with fully manually weeded and other N cycle managed for eco zero weeding of garlic (Figure 6). Fully manually weeded garlic (taken as control) yielded 26q/ha and other treatment support utility of N management with 50 % of Nitrogen fixing crop showed the maximum yield of garlic 114 q/ ha Further. When N is managed by application of aerobically decomposed compost, the yield of garlic had reached to 125 q/ha. The land equivalent ratio (ratio of maximum yield and that/with control) increased to over 3.2. Thus, it is proven that nature based weed suppression will eliminate task of weeding and yield loss will get compensated as well as yield get further enhanced, as revealed by the yield of garlic. The garlic is non tillering crop, hence it is expected that the response of N fixation on tillering crops will be more pronounced than that it appeared in garlic. This scientific method of weeding is entirely different conceptually from that are involved by mechanical machine based weeding. So far no such innovative method of weed management had been invented. This nature based eco weeding eliminates need of weeding; be it by manual, mechanical or through use of any weedicide, which involve huge cost and create environmental problem. The gains are accounted in savings and most prominently by nitrogen fixation which had not been visualized under any kind of weeding by advanced technological gadgets with giant mechanical weeder, robotic weeding machine or even the flame weeding, which is again claimed by the users of flame method of weed control as highly eco-friendly. This aspect will get further substantiated from the results of the study on weed control in crop cultivation of onion [15].

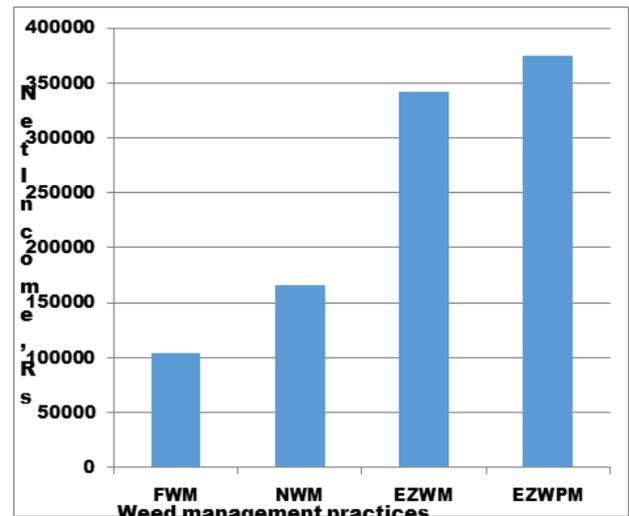


Figure 6. Yield of garlic under nature based eco zero weeding

[FWM-fully weeded manually, NWM no weeding, EZWM eco-zero weed management, EZWPM- eco zero weeding potential management].

3.2. Study on Onion

The onion crop is cultivated during winter season and to some extent during the rainy season. The price of onion shoots up in the market in July-August as the stock of the onion harvested by April gets to an exhausting end, hence the market price soars in general. In order to make some profit during high scarcity, farmers resort to cultivation of onion during the rainy season. However, the weed infestation during the rainy season is so high that it becomes difficult to save crop from weeds. The crops get rainfed moisture supply, but weeds also grow profusely that leads to either no harvest and if harvest occurs it remains with low productivity. Under this situation growing onion with eco zero weed sounds very logical.

The study on onion during the rainy season of 2017 was conducted, but the common practice of allowing the farm weed cutting by outsiders disturbed it so experiment could not be successful. As season got progressed, time for cultivating another rainy season crop of onion was not possible. Therefore a corroborative study [15] on onion was undertaken for the winter season onion. The experiment on onion was based on corollary of results from garlic at Dholi, Bihar (depicted in Figure 6) and the yield results were contrasted with an exemplary study of Sharma et al [16] at Chindwara, a climatic region which is highly suitable for cultivation of onion and garlic in Madhya Pradesh, India.

The yields and economic returns are depicted in Figure 7. The difference between yields of experiment by SRS [16] and that with eco zero weeding corroborated study are so huge that it overcomes any scientific criticism of the study results. The eco-zero weeding based onion weed management produced yield of 875 q/ha, against the exemplary yield reported by Sharma [16]. The scenario of economic return is equally strongly showing the difference. The economic gains with eco zero weeding for onion was Rs 8,16,312 /ha (US \$ 11,830/ha) (US \$ 1=INR69) against that from study Sharma [16] Rs1,94,000/ha (US \$ 2,812/ha). Thus, the economic return ratio was 4:1 at present level of economic

gain and monetary equivalency. The new eco zero weeding for onion was highly profitable against yield with usual practice of onion that is considered as the most satisfying yields.

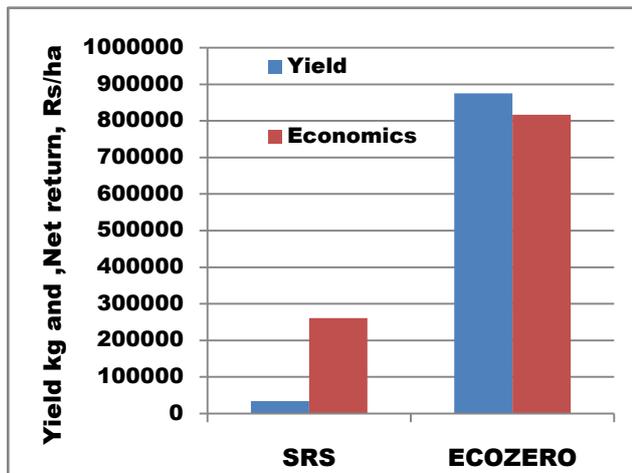


Figure 7. Yield of onion with fully manually weeding against [16] that with eco-zero weeding enforcing nitrogen fixation

Further, study on wheat [17] on eco-zero weeding was conducted, where the fields remained fully weed free and crops performed excellently, giving unimaginable yield of wheat and ongoing study on turmeric with no weed. Thus, the experimental studies produced results that created cent percent success and built strong confidence on working of eco zero weeding.

3.3. Timeline and Research Advancements

The scientist pursued studies on nitrogen cycle management [6-13] and produced results of high merit. Among several reformations of the Nitrogen cycle management, the Eco zero weeding is the first of four in the series. The second innovative development [12] was on practice for making shortfall in pulse production and reduction of emission of GHG nitrous oxide, was declared as winner of World Academic Championship in Chemical Research 2017. Authors another study on harvesting of N from aquatic ecosystems [13] was declared as Winner of World Academic Championship in Biological Sciences in 2018. The author's researches have made agriculture a wildering science in to quantum agriculture by article [9]; was again awarded as Winner of World Academic Championship in Agricultural Sciences, 2018. The 4th innovative research creates new opportunity cropping, which has capability to produce sufficiency of food for posterity. Thus, the researches on nitrogen cycle management by the author are of unique and of extremely high merit. Many of the researches have been in the recent time and have not reached in internet literature review. Hence, the wealth of knowledge ie intellectual properties has not been reaching to the needy academicians and researchers. India inaction is an example of such situations as cited under sub Section 2.3.3. Thus, research which should have gone ahead in creating welfare of global public is impending in one way or the other. Contrary to this, many technologies with plentiful limitations are taking stock of claims of technological breakthroughs, which in reality is not so, as revealed by the study presented here.

3.4. Use of the Technology of Weeding and Research Based Discovery of Eco-zero Weeding

Previous methods of mechanical weeding by any of the machine based methods have their own ideological solutions for universal problems of weeds in global agriculture. Among several mechanical methods the Eco Robotics is a company based in the Canton of Vaud, Switzerland. It plans to launch a fully autonomous weed killing robot. Since the robotic has become new breakthrough on weeding, some little more details are given that will enable readers get apprised of on the advancements in weed management.

The robot is light in weight, but heavy on weeds, as claimed by the Steve Tanner- a Micro technology engineer, came up with this idea about a decade ago and was later joined by businessmen Aurélien G. Demaurex. As a further development abandoning the first project workplace at family barn in Essert-Pittet, they moved to use advanced facilities of Y-Start. The Y-start is an incubator that position itself around regions of innovation and new technologies. This move increased the interest around the project and helped in growing the business. The robot will be primarily used for destroying the weeds by effective spraying of the chemicals.

This financial support permits them to complete the development of their machine and launch it in the market. The Eco Robotics developers claim that their machine offers a concrete solution to both economic and ecological problems of the farming world and makes it possible massively to reduce the use of chemical products,' said a satisfied Aurélien G. Demaurex, co-founder of Eco Robotic.

Thus, any mechanical smart eco weeding giant or small machines operated from various power sources viz, manual, auto or solar or even tractor PTO shaft operated machine involve physical cutting/burning or killing by weedicides. They might be highly effective in controlling weeds, They will be able to reduce crop yield losses to come extent by involving un affordable machine costs. This situation implicates that company in business of weed management has no scientific vision of any alternative approach in mind. Entire move is focused based on development of high technology of robotics in weeding powered by solar panel. In this situation the use of weedicide is reduced, but not fully eliminated. Thus it is becoming established that weed management in the European countries is not going beyond machines and entire endeavors are concentrating business by selling machine of their own make and make huge profit. While wealthy develop countries may be in position to buy and use, get to overcome some loss in yield by weeds, but rest of world, who cannot afford such huge cost involving mechanical machine based technology will always remain cursing for their inability to afford. There might be rush for seeking aids and grants for this technology. This aspect is supplemented by the following paragraphs given in Appendix A.

As evidentiary substantiated that eco zero weeding is scientific discovery which has unlimited scope to save world agriculture from the projected as well as experienced menace of weeds. The research part has made

remarkable progress, but the research is not getting attention of the policy makers and implementers. Thus, invaluable intellectual property is not being taken notice of. It will be a matter of astonishment that even the reception counter of the Ministry of Agriculture, Krishi Bhavan, New Delhi, Government of India is displaying a giant figure of the eco weeder (Figure 3) as depiction of efforts in Indian agricultural research towards advancement. The entire research on this topic is pending for official action. The scientist who invented this discovery has published several articles in the journals of International reputations in support of that submitted challenge accomplishment. Thus, it reveals the zero level of care and concern of researches of such tremendous potential value, what to talk of other researches, in general. It becomes imperative to cite a very popular text book [18] entitled, "Realities in management, Chapter 7," "What can we learn from Japanese management". The chapter emphasizes, among several important aspects, some selected topics are: 1 Innovation encouragement by Government, 2. Zero defect movement, 3 Applying research to business and borrowing ideas. The present discovery on weed management fulfills all requirement of being ideal innovation, zero defect movement, highly applicable research all situations in agriculture and horticulture, production business and easy to get borrowed by any country. The important lessons are not making any dent in India, as well as in the world. The discovery of eco zero weeding is not coming to ear of agricultural research managements, implementers and policy makers. Other countries have not made such wonderful discovery and any developments are coming up they are only from the company based business and profit making ventures. Thus, entire world is moving in environment of pseudo research and remain unaware of real scientific research on weed management based discovery of eco-zero weeding. Hence, the wonderful research is not being brought for the welfare of world gentry and unrealistic blames are imposed for huge global population (remove fig) and allied problems. This research has substantiated and proven workability of eco-zero weeding and further advancement have moved to bring other reforms in eco agriculture.

3.5. Eco-Zero Weeding a Panacea Shrine

The present study has established supremacy in terms of control of crop losses by weed, enhancing yields to unimaginable level, provide cover to protect soil loss by splash and runoff, control of land degradation as it builds nutrient status after harvest of crops [1], it improves environment, it creates prosperity in food production [17] and it can guide public governance with easy food situations in countries of world. This invention is useful in bringing improvement in things around us including food, fresh air, social harmony, market price stabilization and stable governance.

As shown in Figure 8 a new limb in productivity is divergence, which goes beyond the convergence of services. The technology has so much diversified beneficial avenues, people will get craze to adopt it and make their use in the way one can think of. This eco zero weeding agriculture is proven panacea shrine to fulfill and meet

plentiful solutions in agriculture. It is expected that this technology will get extended from word of mouth of its efficacy in different spectrums, by someone who practice it. Thus, eco zero weeding will get adopted without extra extension activities and associated budgets, as happen in the most of cases.

4. Discussion

4.1. The Weed and Weeding Problem

Weeds invasion and getting rid of by suitable measure is a universal worldly problem encountered in the primary productivity activities. The devices being developed for weeding have no significant reduction in loss of productivity. The endeavors have been made for all the times, but nothing went beyond partial or incomplete removal, which take time and involve huge cost.

4.2. World's Scientific Capability for Weed Management

All studies and deliberations have revealed that there had been no scientific capable method for weed management. What had been going on were only gadget based physical or partial destruction of weeds. Only improvement has occurred in the sensing weed, application of weedicides and some other aspects have been made, which are not suitably applicable in most of developing situations. For such reasons and providing better prospects of enhancing yield the discovery has given a wonderful solution for universal insurmountable problem a simple affordable solution.

4.3. Last Status of Advancement in Weeding and Weed Management

So far only machine based or weedicide based weed control measures had been known and some advancements created by research and technological development. This had been in the past, continued and likely to remain for all time in future as well. Thus, there had been a situation of getting to the dead end in the technological breakthrough on weed management until now. The groups who developed robotic weeder, although claim that it as a breakthrough, which is not real, as brought out in the present study, but a scientifically pseudo and unaffordable solution.

4.4. New Discovery

The new discovery is superb, simple, affordable, working all ground and weather situations and capable of bringing unimaginable enhancement in yield. It does not require special machine and gadget, which involve any expenditure for its adoption. This is a real wow discovery for world agriculture and horticulture, and bring several improvement of things around us. It improves environment around us, hence it supplements the basic need of survival. Thus, it is incredible wonderful discovery for welfare of all the global people, be it in developed or developing countries.

4.5. Pro-action on Weeding and Scientific Discovery Acceptance.

So far advancements made on mechanical weeders of different kind getting promoted by the private business group. But the wonderful research has not been given due action resulting in no promotional boost. The publications have not yet entered in internet literature, hence largely not coming to the notice of public at large. There should be some pro-action to create awareness to large extent. This will enable world gentry to use this wow wonderful discovery for betterment of living. It is expected that after first information to users, it will spread very fast, as it is non monetary input involving practice. Then this will create a new world free of weeding problems and bring several reforms around people and environment.

4.6. Compatibility Situation

The compatibility has not made any support in the discovery of real measure for management of weeds in world agriculture. However, on the other hand pseudo advancement have created inadequate technological image of technological breakthrough to foster business and make huge profit. This situation needs some mechanism to boost for turning the situation other way overturn, to enable entire world harness benefit of this wow wonderful discovery.

4.7. New Capable Discovery of Eco Zero Weeding

The new discovery of eco zero weeding has many benefits producing solution of overcoming problems of weeds and weeding. This discovery has capability to create better world than what it is existing at present with insurmountable problems of primary production activities, which serves a beginning point in survival of global life.

4.8. Highly Suitable Technology for Weeding Management Enterprise Organization

Productivity of any system is controlled by various factors viz technology development group job performance, finance, and convergence of service (Figure 8) [19] and further update in the present study. Since weeds cause lot of problems and can be removed with different degree of efficiencies and having productivity, their perfect use and harnessing advantages are of immense importance. The International Water Management Institute (IWMI) Colombo, Sri Lanka provoked white spot technology [20], which glitter for some time and get surpassed by new one emerging other ones, but eco zero weeding is another sun technology to supplement and enhance the sun technology viz Racy nature agriculture [9] and create still brighter sun shine for everywhere and all the times.

The eco zero weeding will become a good venture to carryout weed management at a farm level. The various factors involved in the contractual work can be performed on the basis of degree of removing weeds and second on the basis of enhancement in productivity of crops. The new discovery fulfills all requirements of better use, intensification and diversification and targeted use of

fixed resource viz land. People should be trained for effective group job, financial issues, though manageable, should be smothered in operational research and likewise convergence of services duly used and promoted. The activities involved can be provided at different rates, viz area coverage, productivity enhancement, group job management training and convergence of services. What a farmer or stake holder is investing on machine can get the service by coming in agreement for application of zero weeding. This will be good scope for developing soft skilled business in lieu of mechanization. Some negotiating management enterprise can be formed, which will even surpass the robotics for weeding. This opportunity is possible with this discovery, which otherwise is not with mechanical gadgets.

4.9. Simple, Supportive Scientific Measure to Counter Global Warming

Eco zero weeding is practice, which revealed certain facts about contribution of weeds to the emission of GHG nitrous oxide. The simple measure is applicable for lawns, gardens, non arable land forms, where weeds grow and emit continuously nitrous oxide, an anthropogenic emission of nitrous oxide, a prominent GHG of prime importance. This fact is a new scientific knowledge development in environmental science. The present study has discovered this new scientific fact and the eco zero weeding is new solution for unnoticed and not discovered scientific fact that weeds also contribute nitrous oxide.

The eco- zero weeding does not add any carbon foot print, instead it eliminate any field operation that might add carbon food prints. Whatever be the machine, their field operations will certainly add carbon foot print. Further, the industrial manufacturing process will add tremendous carbon foot print.

The eco-zero weeding will fix nitrogen that will get simultaneously utilized by the crop plant and net N reserve in soil will be low creating emission of the nitrus oxide (N_2O) will be low as established by authors study [12]. Thus, the eco-zero weeding is strong and truly eco-friendly and protecting environment.

4.10. Summary of Usefulness and Related Actions

I. Potential Uses of the Discovery

1. The yield losses caused by weeds in agriculture and horticultural crops are eliminated.
2. Deprivation(s) of soil nutrient, moisture, solar radiation and ground space causing competition is eliminated.
3. Enhance dynamic fixing of atmospheric Nitrogen to boost yield and thereby efficiency of natural resources of land, water, solar radiation, and space.
4. Eliminate weeding and inter culture secondary tillage operations, thereby reduce labour input in agriculture and reduce carbon foot print in agriculture.
5. Reduce emission of green house gas (GHG) nitrous oxide (N_2O) causing depletion of ozone layer and creating several health hazards. Nitrous oxide precursor of O_3 .
6. Reduction of soil erosion as no tilling is involved, hence no disturbance as surface remain covered with green protective canopy.

7. Builds nutrient supply enabling crops perform with reduced demands of external input of N and P.
8. Enhance supply of oxygen in to atmosphere by fostering photosynthesis of biological process to build carbohydrate and oxygen to maintain livable environment. The n fixation foster green colour in the crops, which foeters increase in photosynthesis and more release of O₂.
9. Enable manoeuvre moderate adverse agro ecosystem to produce biodiversity.
10. Makeup shortfall in pulse production for pro vegetarian gentry in country such as in India.
11. Elimination of need of chemical weedicides for weed control, a world environment disaster.
12. The eco zero weeding will always be working and not get adversely affected by the unfavorable ground condition.

II. Indian Inaction on the Scientific Innovation

1. The discovery is submitted to ICAR, Krishi, Bhavan, Government of India, New Delhi under ongoing scheme of challenge award, but no action is being taken to process it.
2. The author has published this research in leading agriculture inventive journalsv viz Innovative techniques in Agriculture Scientica Ricerca in USA and International J of Ecology and Ecosystems.
3. In the *Krishi Bhavan* lobby a giant weeding machine is fascinatingly being displayed as a scientific advancement

to build image in visitors mind the country is striving in agriculture.

4. Other companies have also made their weeding machine.
5. Switzerland had developed a robotic weeding machine and almost 25 countries have joined hand to make huge business.
6. A small weed killer machine is developed, which claims to reduce load of weedicides
7. These machine and any technology will fail to work under aberrant weather conditions that are progressively increasing due to global warming and climate change.
8. In north east region crops are sown by broad casting due to soil, cropping pattern and socio-economic status of the farmers. With these limiting conditions the mechanical weeder or for that matter robotic weeder will not work, hence it shows peculiarity of weed control in agriculture and horticulture.

4.11. Relevance, Effectiveness, Efficiency, Impact and Sustainability (REEIS)

The new discovery based weed management is highly relevant, effective, impact creating and sustainable. There is no solution which can beat this weed management technology.

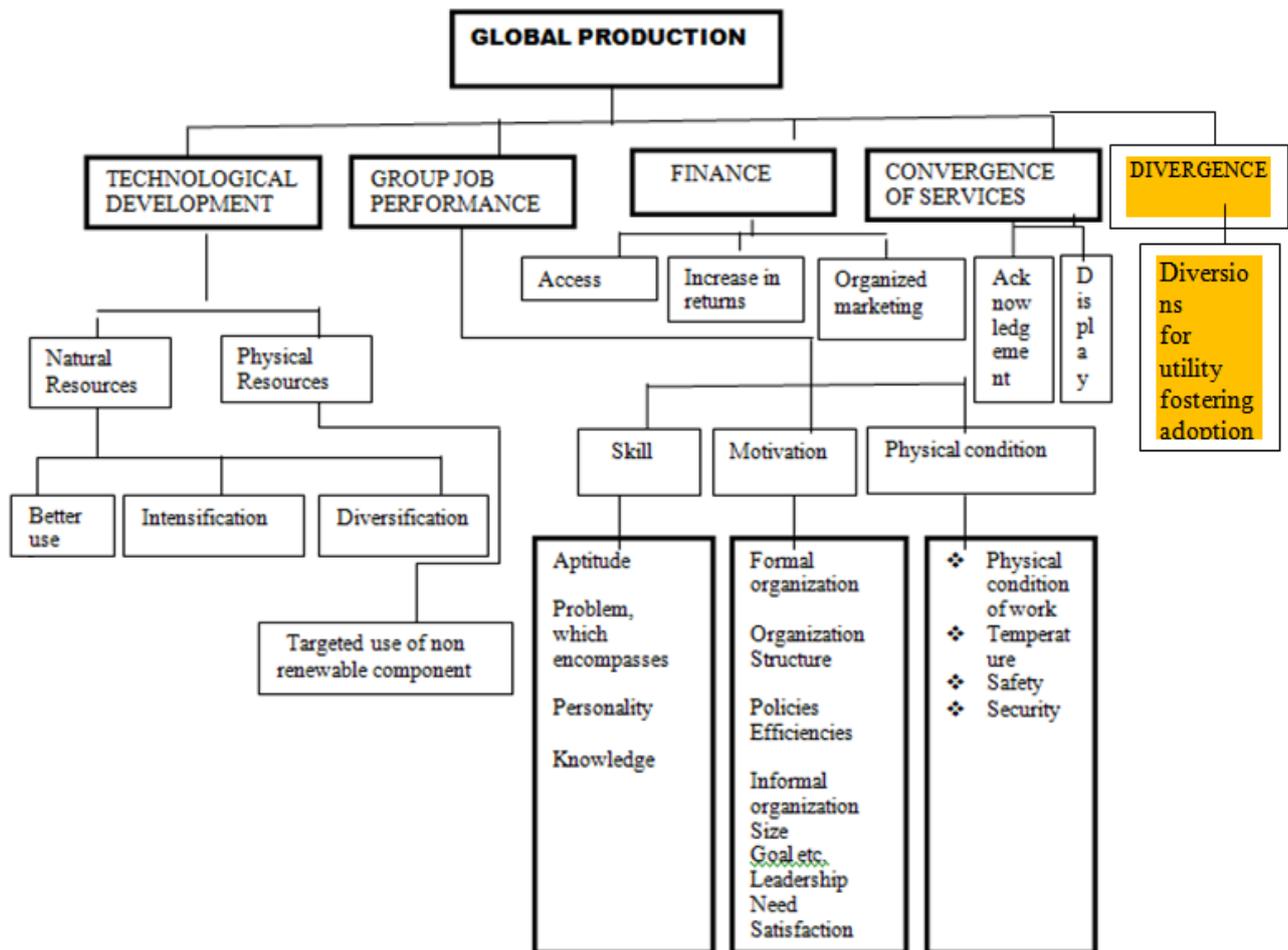


Figure 8. Perspective of Global applicability of technology of eco-zero weeding [19] and spdate in the present study

4.12. Strength, Weakness, Opportunity and Threat (SWOT) Analysis

The eco-zero weeding is based on sound principle of ecology, environmental sciences and engineering, crops and cropping practices, soil science, soil chemistry, soil physics and plant science, hydrology and irrigation. It is knowledge intensive hence it has very high strength. It is free of any weakness of any kind. It provides tremendous opportunity for its adoption and producing good effects. It is also free of any threat. All these aspect go in strong favour of eco-zero weeding.

5. Conclusion

Weed menace a worldly problem come to attention of the technology savvy groups, who resorted to make big business with advanced knowledge in machinery development viz smart machine and robotics. They focus problem of weeding in perspective to form development of global business. Nevertheless, their measures were not likely to accomplish task of weeding in perfection anything beyond killing weeds. In the present research a wow incredible innovation was made which is capable of overcoming problems of weeds and bringing panacea solutions in agriculture, affordable by all developed and developing countries. The multidirectional benefits will equip world with new intellectual property, which will enhance yield, reduce global warming and climate change. Eco-zero weeding will transform the eco system to be highly productive, responsive and enable acquiring saving of resources.

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Appendix. A



Global Robotic Weeding Machines Market 2018-2022 to Post a CAGR of 23%| Technavio

Technavio has published a new market research report on the global robotic weeding machines market from 2018-2022. (Graphic: Business Wire)

June 13, 2018 01:08 PM Eastern Daylight Time

LONDON--(BUSINESS WIRE)--The global robotic weeding machines market is expected to register a CAGR of over **23%** during the period 2018-2022, according to the latest market research report by **Technavio**.

The global robotic weeding machines market is expected to register a CAGR of over 23% during the period 2018-2022, according to the latest marketresearch report by @Technavio. Tweet this

A key factor driving the market's growth is the need for weed control. Over the years, there has been an increase in the awareness of plant invasions by weeds that can cause severe ecological, agricultural, and health concerns that lead to economic losses. There has been an increase in the adoption of techniques, which can reduce the dependence on agrichemicals to protect beneficial weeds such as the ambrosia artemisiifolia.

This market research report on the **global robotic weeding machines market 2018-2022** provides an analysis of the most important trends expected to impact the market outlook during the forecast period. Technavio predicts an emerging trend as a major factor that has the potential to significantly impact the market and contribute to its growth or decline.

This report is available at a USD 1,000 discount for a limited time only: View market snapshot before purchasing

In this report, Technavio highlights product innovations as one of the key emerging trends in the global robotic weeding machines market:

Global robotic weeding machines market: Product innovations

Vendors in the global robotic weeding machines market have started incorporating technological innovations, which can improve the efficiency of their offerings. These robotic machines are empowered with the abilities to assess the number of rows, distance between rows, and growth stage of the crop. The robots are also equipped with machine learning and deep learning capabilities so that they can distinguish between crops and weeds with precision.

"In terms of navigation, there have been improvements to ensure autonomy and maneuverability with minimal damage to crops. Vendors are intensifying their efforts to ensure real-time kinematic GPS technology is implemented. The focus has been on implementing improved imaging capabilities to ensure that plants can be visually characterized," says a senior analyst at Technavio for research on robotics."

Global robotic weeding machines market: Segmentation analysis

This market research report segments the global robotic weeding machines market into the following products (software, hardware, and services) and key regions (the Americas, APAC, and EMEA).

The software segment held the largest market share in 2017, accounting for more than 48% of the market. This product segment is expected to dominate the global market throughout the forecast period.

EMEA held the highest share of the global robotic weeding machines market in 2017, accounting for a market share of approximately 57%. In EMEA, countries such as Germany, France, the UK, Italy, Switzerland, and the Netherlands are among the major revenue contributors.

Looking for more information on this market? Request a free sample report

Technavio's sample reports are free of charge and contain multiple sections of the report such as the market size and forecast, drivers, challenges, trends, and more.

The infographic is divided into several sections. The top left section features a blue background with a yellow and blue circular graphic and text stating 'The market will be ACCELERATING growing at a CAGR of over 23%'. The top middle section, titled 'INCREMENTAL GROWTH', shows a bar chart comparing 2017 and 2022, with a value of '\$80.85 mn' for 2022. The top right section has a blue background with a yellow bar and text stating '48% of the market share originated from the SOFTWARE SEGMENT in 2017'. The middle left section has a green background with three horizontal arrows of increasing length and text stating 'The HARDWARE SEGMENT has a HIGHER incremental growth than the SERVICES SEGMENT'. The middle right section has a teal background with a lightbulb icon and text stating 'One of the KEY TRENDS for this market will be the PRODUCT INNOVATIONS'. The bottom section has a dark blue background with a white box containing the report title 'GLOBAL ROBOTIC WEEDING MACHINES MARKET 2018-2022'. To the right of this box, it says '10,000+ reports covering niche topics' and 'INDUSTRIAL AUTOMATION'. Below this, it says 'Read them here: www.technavio.com' and features the Technavio logo.

The market will be **ACCELERATING** growing at a CAGR of over **23%**

INCREMENTAL GROWTH
\$80.85 mn
2017 2022

48% of the market share originated from the **SOFTWARE SEGMENT** in 2017

The **HARDWARE SEGMENT** has a **HIGHER** incremental growth than the **SERVICES SEGMENT**

One of the **KEY TRENDS** for this market will be the **PRODUCT INNOVATIONS**

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